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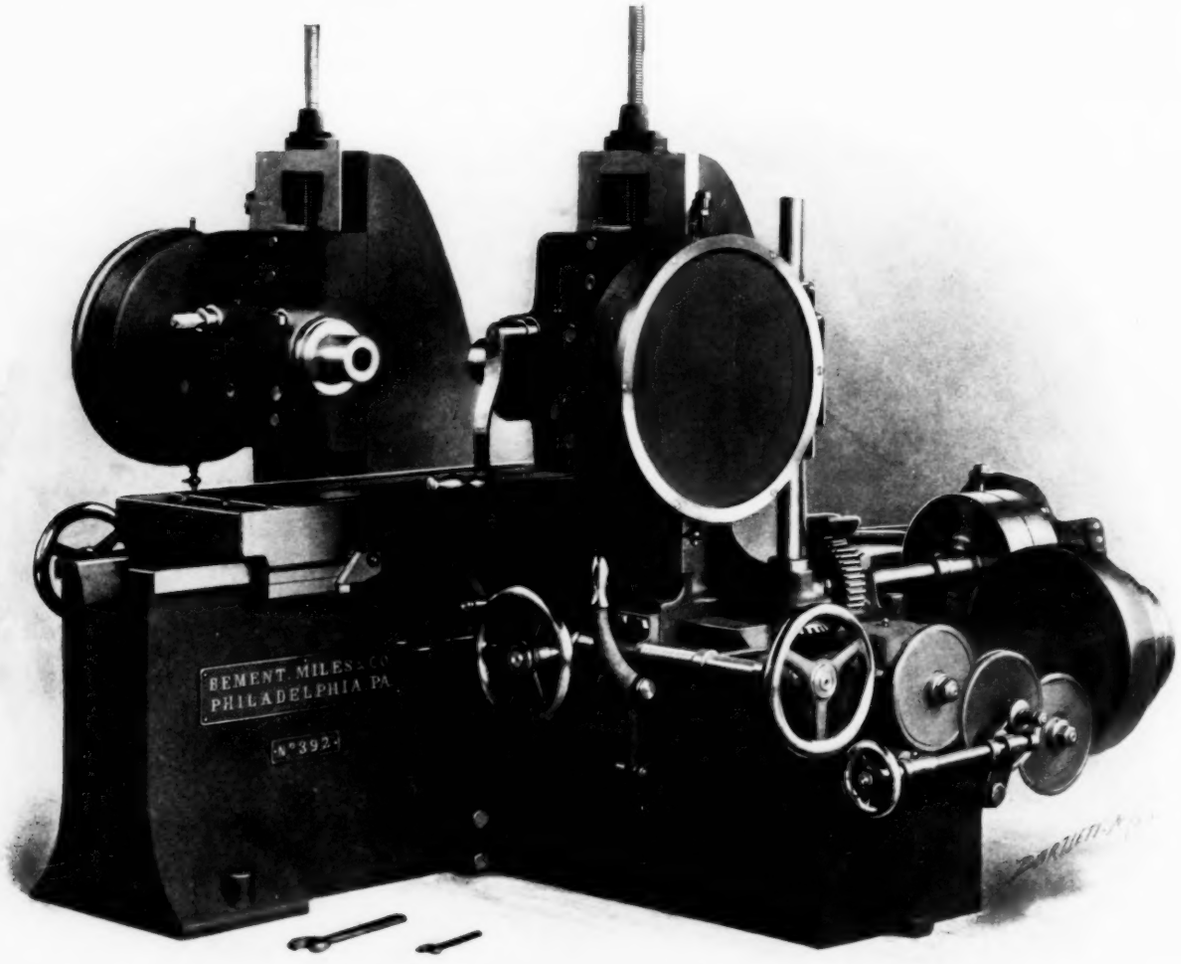

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A Good Machinist With Only One Hand.

Gustave E. Soderbaum came to America ten years ago to better his condition in life. In Sweden, where he was born July 4, 1856, he had learned the machinist's trade and the art of engraving. In 1879 he married Mary Peterson, and seven children have been born to them, two of the children as well as their father having for their birthday that which we celebrate as the nation's birthday. Fourth of July is, as may well be imagined, a great day in the Soderbaum family, and so when that day last came around there was to be a celebration. But somehow as Mr. Soderbaum was loading a small cannon with which he was celebrating in the truly American style, it was prematurely discharged and his left hand was so badly shattered that amputation was necessary.

During the long weeks of suffering and enforced idleness that followed the brain of the afflicted man was not idle. He felt the weight of his responsibilities and determined not to give up or to undertake a new employment that would involve the throwing away of his acquired skill and training; he wanted to continue work as a skilled machinist, and though it is probable that most men would have given up all idea of doing so under the circumstances, he did not give up, but tried to think of ways and means of keeping on. The accompanying photographs will show how splendidly he has succeeded. Before the accident he had been working as a bench hand at the works of the Deane Steam Pump Company, at Holyoke. He wished to return to this position, but before applying for work, experimented a little and consulted a New York manufacturer of artificial limbs, who, with his experience, helped to carry out the ideas of Mr. Soderbaum. At home a bench and vise were fitted up, and it was there demonstrated that work was possible, and finally a degree of proficiency was again attained in the use of tools, that gave confidence, so that the day came when he resumed his place. The foreman of the shop tells me he has never given him a job he could not do—that in fact he seems able to do all kinds of work with the best of them, including chipping and filing, scraping, etc. This he does with an attachment to the arm which probably differs considerably from any other ever devised.

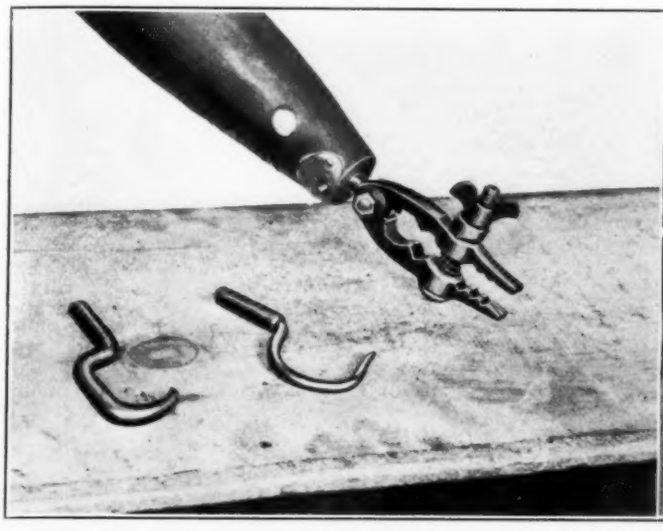


FIG. 1. A MACHINIST'S SUBSTITUTE FOR A LOST HAND.

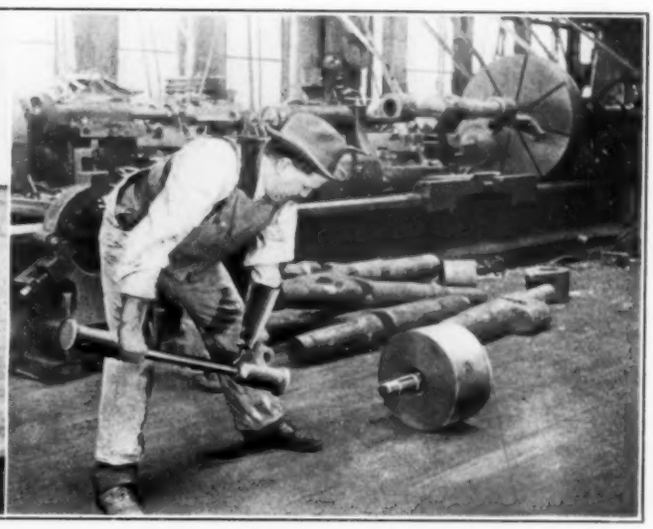


FIG. 2. DRIVING AN AREOM.

Fig. 1 shows the attachment of the arm with the vise in place. This vise was made by its user, and is for holding chisels, center-punch, letter stamps, etc. It fastens into the socket by a spring and screw and can be quickly removed to substitute one of the hooks seen lying on the bench when one of these is called for by the nature of the work.

Straps go over his shoulders to form a support when lifting or doing heavy work.

FIG. 3. CHIPPING A CONNECTING-ROD END.

FIG. 4. SCRAPING A BEARING.

FIG. 5. FILING A VALVE-ROD LINK.

is in Fig. 2, where he is seen driving an arbor with a lead "bunter."

Fig. 3 shows Mr. Soderbaum in the act of chipping a connecting rod, and shows the arm and straps attached which go around his shoulders.

Fig. 4 shows him scraping a journal box cap, after being babbitted, and in Fig. 5 he is filing a valve rod link to fit tappets, this being a good job for a man with two hands. Mr. Soderbaum files them just as straight as he ever could, and as quickly, also filing connecting rods and boxes.

In view of the fact that so many surrender easily in the face of difficulties, it seems as though Mr. Soderbaum is entitled to a great deal of credit, and I hope this plain story of his heroism, written by a shop mate, may be an inspiration and a help to others who may be tempted to think their difficulties are too great to be overcome.

C. W. PUTNAM.

Holyoke, Mass.

The Patternmaker's Lathe.

BY JOHN M. RICHARDSON.

Not every shop possessing a patternmaker's lathe is deriving the good from it which might be obtained, simply through the lack of proper tools and accessories, so, while I have nothing original to claim in what follows, still there may be a little meat in the kernel for someone.

By a patternmaker's lathe, in distinction from an ordinary hand or speed lathe, I mean one with a movable carriage, having a slide or compound rest attached, holding a tool-post. An ordinary rest-holder and set of rests usually go with one of these lathes in addition, but I believe in discarding this feature entirely, and, when using ordinary hand-tools, just place a plain bar in the tool-post and use this for a rest instead; for it does not pay to be continually changing the rest-holder. Even this will not in all cases be necessary, for it often happens that when some corner is to be rounded or fillet made, which cannot be conveniently done with the tool in the tool-post, a hand-tool can be used to finish the place by holding it right on this fixed tool in lieu of a rest.

It is not every job by any means that can be most economically done with fixed tools, and here is where good judgment and common sense must take their turn, using the carriage and slide-rest where time can be saved, and the hand tools when their use will be the most expeditious.

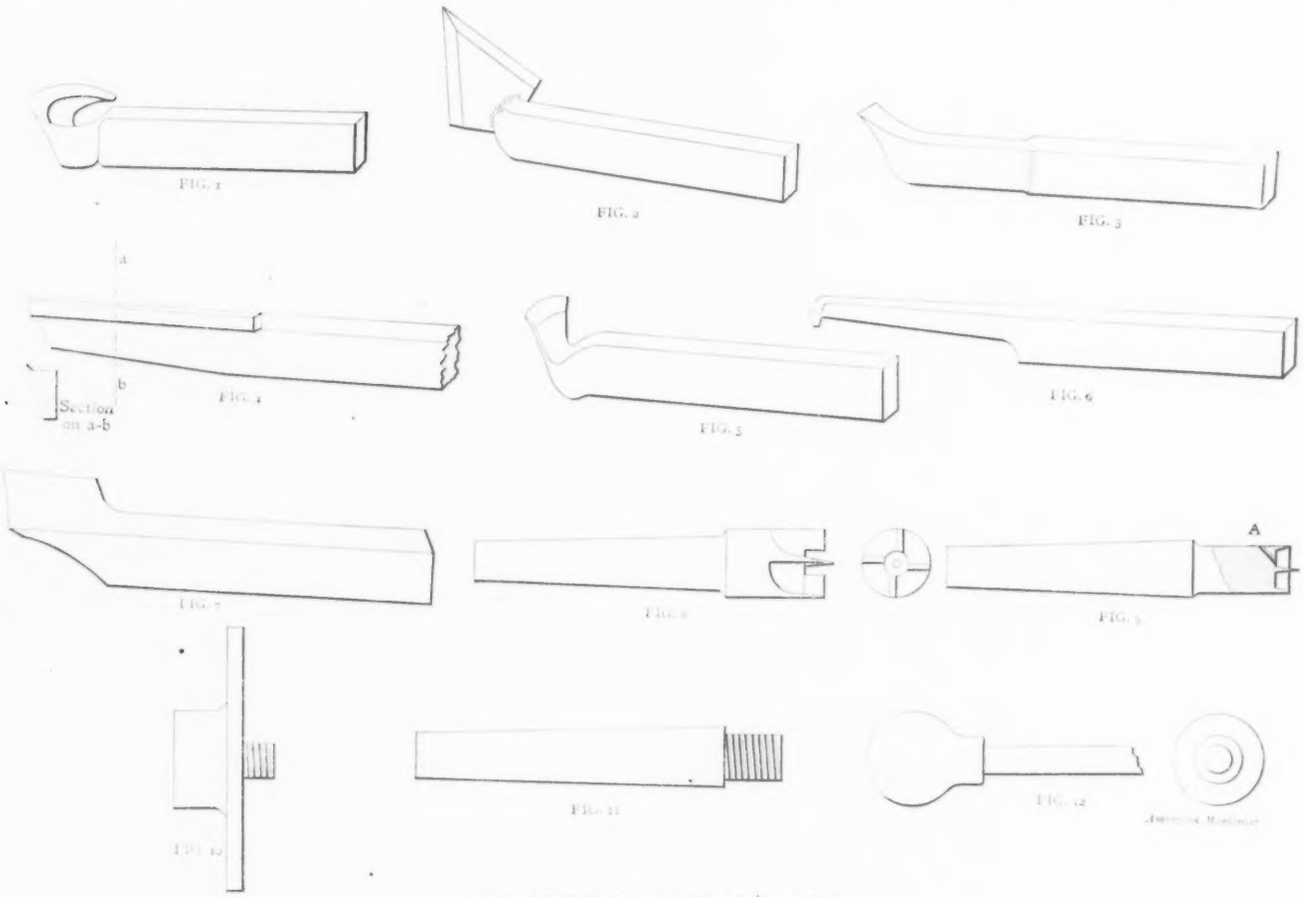
Often a combination of both ways on the same piece of work is best. For very small turning, a regular speed lathe is of course the handiest. But, to return to the subject, let us examine the patternmaker's lathe somewhat closely, and try to note a few features that will help to do accurate work quickly and easily.

One with a swiveling headstock is far ahead of those of the fixed type, and it should move through an arc of at least 3 degrees each side of the *O* mark, and when at this mark, it is a most excellent plan to have it located by a taper pin set just back of the index mark on the movable portion of the headstock. This makes the setting sure before the screws are tightened, without relying on graduations which a careless workman will occasionally fail to match properly, and then the work done by the carriage is sure to be tapering. I know of two shops, each having one of the most widely known makes of patternmaker's lathe, that have had the taper plug fitted themselves, because the makers did not.

It has been my experience that, on general patternwork, the tailstock will not be set out of line once in fifty times compared with the headstock, for the latter is constantly being shifted to get the necessary draft on all faceplate work of any depth. The compound rest on the carriage should swivel, and be provided with graduations from 0 to 90 degrees in each direction, to facilitate such turning as gear blanks, etc.

About the most important feature, outside of the bare lathe itself, is the question of tools for the tool-holder. I have had a chance to see and study the effect of quite a number of shapes, in the different shops where I have been, but have not seen them all, and if anyone knows of a style that will cut smoother and faster, I hope to read about it in these columns later on.

Fig. 1 is a roughing-out tool. The cut



TOOLS FOR THE PATTERNMAKER'S LATHE.

ting edge should slant downward somewhat as it approaches the end or tail, to give a drawing cut, and the outside face ought to overhang at least 10 degrees from a perpendicular all the way around, so as to take hold nicely at the very edge, and not have any point of contact below where it is doing work, to retard its action. An emery wheel about 8 inches in diameter gives a good concave to the outer face, and when this tool has a few finishing touches with an oil stone, it is surprising to see the heavy chips it will take from a rough piece, without even previously removing the corners.

Fig. 2 shows the "arrow point" tool for finishing, and it should be set slightly angling to the work. When properly sharpened it will cut almost as smooth as glass, and on straight work, like rolls, etc., it works as nearly perfect as one could wish. The action, it will be noticed, is similar to a wood-turner's skew chisel.

Fig. 3 is a cutting-off tool, which does not tear and scrape like the ones generally used, that are flat on top. It is intended to be sharpened on an emery wheel, about 6 or 8 inches in diameter, and then be touched up on an oil stone, as in fact are all that I am describing. The curvature on the upper side of this tool allows it to enter the work easily and take a fast cut, while the curve below removes the stubbed end frequently seen on tools of this class. One of these tools, made in every respect like Fig. 3, except with a wider cutting face, is excellent for shouldering down on work. With it a number of cuts can be made down to almost the diameter required, then get the exact diameter, and finish by moving the carriage along. The tool cuts quite smoothly moved along in this manner, but not quite as well as the "arrow point."

Fig. 4 is a boring tool, and there should be one right and one left. I have used tools of this shape a great deal, and for deep boring I know of nothing better. They also work equally well on outside work and are especially useful when the piece being turned is too large in diameter to slide the carriage along under it, for it can be placed in the tool-post in such a manner as to overhang a long distance, and work clear to its limit.

Fig. 5 is a nice tool for facing off segments and the surface of any disk which may be on the face-plate. It works quite well also when turning on the outside diameter, but is especially for facing.

Fig. 6 is a boring tool which is useful in holes of small diameter where the one shown in Fig. 4 cannot be conveniently operated. Fig. 7 shows a tool for general work, which is good for smoothing and shouldering down. It will be noticed that it has two cutting edges which can be used, and the top is shaped by the curve of the emery wheel something as in Fig. 3. The angle of the point should be less than a right angle, as if so made the tool can be set so as to be started in with the slide rest, and then be stopped and moved along by the carriage. A much deeper chip can be taken with this tool when the carriage is moved than with the one shown in Fig. 3, as its action is more of a drawing cut.

I want to find a little fault with the spur and cup centers, as sometimes sent out by the makers with a new lathe, and will give my reason for it: The spur or point in each of these is apt to be too large. A very large percentage of work performed on a pattern-making lathe between centers is done in halves, and it is very important indeed that the lathe center comes exactly in the joint between the halves mentioned. In work of this nature it is the outer spur points of the live center and the ring of the cup center that, in addition to its other fastening, holds the work, and not the central point. The action of this latter is, if anything, to spread the pieces apart, and it is useful only as a guide in correctly placing the lathe centers in the piece to be operated on. For this reason they should be a little longer than the rest of the center, taken as a whole, and be slender points, so that they can be pressed easily between the halves of the work, and so that when removed the eye readily detects if they are out at all. In placing centers in work when in halves, it is safer to take each center and put it into the piece before placing it in the lathe, and then look to see if the slender point is exactly on the dividing line, and if it is, drive in the center with a blow from a lead hammer, and transfer to the lathe. This gives a chance for adjustment at a time when the work can be easily seen.

I actually knew of a spur center of the style shown in Fig. 8 being put out by a prominent lathe firm, in which the entering point was ¼ inch in diameter where it gives into the solid part of center, and tapered to a point 17-32 beyond the ends of the four knife spurs, and the diameter of this center in the largest part was but 1¼ inches. It is really cruel to a small piece of work in halves, to force such a mass of steel between the pieces when it cannot help to hold them together in the slightest degree.

A cup center, Fig. 9, should be straight on the outside and beveled on the inside to a slender edge or ring. This form has the action of a pinch-dog to some extent, and helps somewhat to hold the two parts from separating. An oil hole should be provided as at *A*, and the center always be placed in the tailstock with this uppermost.

Face-plates having a shank in the middle for centering and chucking work, as shown in Fig. 10, are used in some places, and cannot be too highly recommended, especially on pulley and gear blank work, etc. The best form of this that I have ever seen is the threaded kind. The shank proper is standard size (¾ inch diameter) its whole length, and should not project less than ½ inch nor more than ¾ inch, and around this shank or spindle is a very thin thread like a knife edge, at the rate of 8 to the inch, and the more like a knife edge this thread can be the better, for then it will not injure the hole in the work in the least, by throwing it out of center, or hurt it for receiving core print shanks or plugs of any kind. It is better to have this thread start at least 1-16 inch back from the end, so that the hole in the work can be squarely placed before commencing to screw it back against the face-plate.

It will be found that a vast deal of work can be done without using any wood screws through the face-plate to help hold, relying only on the threaded shank.

Sometimes this centering principle is needed to be used in connection with some face-plate not fitted with this device, in which case have a lathe center made as in Fig. 11, with the end fixed exactly like the one in Fig. 10, so that it can be used equally well with all the face-plates belonging to the lathe, and projecting beyond them the same distance. When this latter scheme is employed, wood screws can also be used to help hold when the work is large, but of course must be put in and withdrawn while the face-plate is in the lathe, in its position against the collar on the spindle.

A knob cast or screwed on the end of a long rod, as in Fig. 12, is useful to have within reach for a rammer, to put through the spindle in removing centers. It is handier than a plain rod, and the additional weight gives it a more effective blow.

Finally, I would like to impress the importance of never hammering or pounding anything connected with the lathe, except with a soft hammer. A lead hammer of convenient size should always be kept about a lathe, as one of the accessories, just as much as the tools and face-plates.

Echoes from the Oil Country.

CHASING A MISTAKE.

The same job had been in once before, and they had some trouble with it then. You see there were several motions to the machine, and that gear had to be keyed on just right or there would be a grand bust-up when the thing was started. The gear had given out and they had knocked it off and left it and everything else they could at home, bringing only the shaft with such parts as were fast on it. As the shop had made a pattern for them (before they knew whether the sizes would come right) and as it was over twenty miles drive each way, and they were in a hurry, they did not wish to handle any more weight than they had to.

Their being in such a big hurry had been the cause of Charley's having to get an early supper and being at the shop ready to rush that newly cast gear as soon as it was safe to cool it. That meant working with a casting all sand, and having to

scrape off the teeth and chip and file them here and there, and wonder why a casting for a hurry job is always rougher than ordinary, especially if the job has to be done at night and the owners are standing by and not hiding their impatience very well. Anyone who has been there knows that such a casting will be hard and that tools will act differently than on regular occasions. We all know, too, that this kind of thing does not tend to make a man think any clearer; but all things come to an end sometime, and 2 o'clock saw the job leave the shop and Charley start for home.

About 7 o'clock he awoke with a start with his mind full of the idea that he had keyed that gear on wrong, and that if those fellows connected up without seeing it, something would suffer, and likely somebody, too, and he was likely to come in for the big end of it. He got to the shop as soon as he could and hunted up all the fellows he could find that knew anything about the trouble the first time, and he was thoroughly convinced that he had sent the job out wrong.

There was only one thing for it, and he hunted up the Old Man and explained the matter to him, and was directed to go to the livery stable, get a horse and cutter and take such tools as he needed and follow the job and try to catch them before they would have time to get things together and started.

He did as directed, and after a hard drive got to their place just before noon. He had been somewhat delayed inquiring for them, as, beyond knowing the name of their post office, he had very little to guide him; but luck was with him, and he found them just finishing putting the job together and intending to start up the first thing after dinner.

Examination showed that the gear was keyed on wrong, sure enough, and they had never had any idea of it, but had just tried the gears to see they ran smoothly enough, doing this before finishing connecting up, as it was too hard to pull around by hand when everything was connected on.

Charley had taken particular pains to have everything go together tight on the job and it was no easy matter to get the key out and the gear off, and then a new keyseat had to be cut after the proper place was found, and it was after 11 o'clock at night when finally the finishing touches were put on and everything was pronounced in running order.

As he had been up so late the night before, Charley asked them to let him sleep until 8 o'clock the next morning, which they did. He awoke to find a warm wind blowing and the sun shining out soft and bright in a way that filled the tracks in the snow with water and warned him to hurry up a little if he expected to get back on runners.

He lost no time in getting his breakfast and getting started, but had not gone far before the cutter began to strike bare spots. Soon they became so frequent that he was dodging back and forth trying to avoid them. The next thing he tried driving along in the ditch where the snow had drifted in, but the ditches began to be ponds and this did not help him any.

A bright idea struck him—he would borrow a buggy and leave the cutter. He tried this, but the farmers had evidently been reading all about the sharpers that prey on the unsuspecting ruralist, and his advances were received with suspicion. Again and again he tried, but no; he could not get the poorest kind of a trap that had wheels. To add to his discomfort he discovered he had left home without any money, except a few cents in change, and he was not on the line of the telegraph. In despair he tried to get a farmer to haul him in and keep the horse and cutter for security for his pay, but the farmer by his manner evidently thought he had stolen them and, finding the snow going, wished to abandon them before the owner came up.

The situation became so serious that he was meditating tying the horse up in some sheltered spot, blanketed with the lap-robe, and starting to walk in. The grind of the runners on the mud and gravel was maddening, and between the warm day and the hard work the horse was sweating very freely and had to be rested often.

As he went along, sunk in the slough of despond (and mud), he came to a small creek, which he found had overflowed its bank and covered the road for perhaps a quarter of a mile, and along in that stretch was a bridge where the stream crossed the road. Here was a situation—fields swimming on either side; no house near; no idea of how deep the water might be; no recollection of how the road lay or how large the stream was. The only thing at all consoling was the railing on the bridge, that showed up high enough to show that there could not be much water over the roadway; but that was no proof that the water was not several feet deep in some spots away from the bridge—and you know shallow water looks as imposing as deep water when you don't know it is shallow.

Charley sat for quite a few minutes looking around and thinking if there was any other way to get home. To the left the country was hilly and likely to be rough and rocky, and he did not know how the roads ran, and, besides, it was getting decidedly after noon, and he was without dinner, and his feet were wet from trying to walk and so save the horse.

He wasn't sure just then that drowning was much worse than being a jobbing machinist, so he stirred the horse up and started into the water and finally reached the bridge without the water coming into the cutter. The bridge felt rather shaky, and he felt relieved when across it, but soon found the water coming higher. Stopping the horse, he folded the robe, laid it on the seat and perched up on it the best he could, and then started again. The water rose inch by inch until it was over the sides of the cutter, and he was wondering if it would float before they got through. After getting to within a couple of inches of the seat it began to go down again, and by and by they were through and slowly crawling through the mud again.

The lights were shining from the houses and supper time was past before they reached town, and now Charley thinks a watch, some money and a certificate of character will be part of his outfit if he has to go out among strangers on jobs. When he gets to be a seasoned outside man he will know that a knife, some string and several pins will also come in handy, and that there are good and bad ways of tackling the farmer, the same as in going at any other job. But he was young.

W. OSBORNE.

Paterson's Fame in France.

Not long after the notoriety of the Paterson, N. J., anarchists had been gained by the assassination of King Humbert, a machinery man had rather a strange adventure in Toulon, France. The man in question is James Rath, whom a good many Americans met in the summer of 1900, as he was employed by the British Jones & Lamson Company and was in charge of their machine at the Vincennes annex to the Paris Exposition. Mr. Rath is described as a man who has "read the AMERICAN MACHINIST from his youth up," and, though he has never been in America, is exceptionally well informed regarding American machine tools and American machine shop methods. He travels a good deal about Europe fixing up machines and making suggestions, and at the time in question he was in Toulon in the interest of Philip Bonvillain, a civil engineer of Paris and agent for a number of American machine tool builders. Something unusual was going on in Toulon, and in a restaurant there Mr. Rath was sitting one day with a satchel or bag at his side which had a short time previously been in the hands of Patterson & Co., the well-known express forwarders of London. One of their tags was pasted upon this bag, and the lynx-eyed police officer, seeing the name Patterson, immediately connected this with Paterson, N. J., and as Mr. Rath was speaking English and at the same time might by a slight stretch of the imagination be thought to resemble an Italian, the vigilant guardian of the public arrested Mr. Rath and took him to police headquarters, and there was considerable telegraphing back and forth between Toulon and Paris, extending over several days, before our machinery man was released; Mr. Bonvillain's word in fact not being accepted as being reliable, and the supposed dangerous anarchist from Paterson, who had never seen Paterson, nor even America, was rigidly secluded from the outer world until a high

official in Paris was finally convinced of his innocence and telegraphed that he must be released.

Dies for Punching Leather Shoe Tips.

BY JOSEPH V. WOODWORTH.

For the production of shoes and various other articles of leather the parts of which are required to be pierced in fancy designs, the work of the toolmaker plays an important part, as the variety and number of tools used is very large, and as they are kept in quite constant use even their renewal gives employment to a large number of men. In a preceding article, page 156, I have described a number of tools used in the manufacture of the perforating disks or wheels which are used for piercing simple or *straight* designs in leather, and in this I will endeavor to describe the means employed for the production of the more elaborate designs, which are accomplished by punching.

In Fig. 1 are shown samples of work, full size, produced in this manner, and in Fig. 2 is the type of die used. The construction of the dies for their production entails a lot of accurate work, both in the laying out of the shapes and designs and in the finishing of the tools.

The principles of construction carried out in these dies differ somewhat from those involved in the construction of dies for piercing sheet metal, as the conditions under which the tools are worked and the material pierced are different. In Fig. 2 is shown a die complete, and in Fig. 3 are the essential parts of the same. In Fig. 3 are the die plate, the stop and the stripper. The die is made to pierce eighty-eight holes of comparatively small diameters. This number is small compared with some designs. The crown shown in Fig. 1 requires 137 holes, and others even more.

For the die plate, Fig. 3, a piece of annealed tool steel is finished all over and about 5-16 inch thick. The stripper plate is then got out and finished to a thickness of 5-32 inch. The stripper plate is clamped to the face of the die plate and holes are drilled for the two dowel-pins, as shown at *D D* in the die plate and at *K K* in the stripper. Three more holes are then drilled for the fastening screws, as shown at *F F F* in the die and at *J J J* in the stripper. The two dowel-pin holes are carefully reamed, and the stripper is removed from the die. The three screw holes are tapped in the die and enlarged in the stripper for clearance, and the two dowel-pins are made of Stubs steel and forced tightly into the holes *D D* in the die.

We now take a piece of hard sheet brass and, after getting it perfectly flat, the design is laid out upon it, the holes are spaced, prick-punched and drilled to size. In the making of this templet care must be taken to get it accurate and the holes evenly spaced for the design to present a symmetrical and artistic appearance. Note the fancy design of the templet shown in the half-tone, Fig. 4.

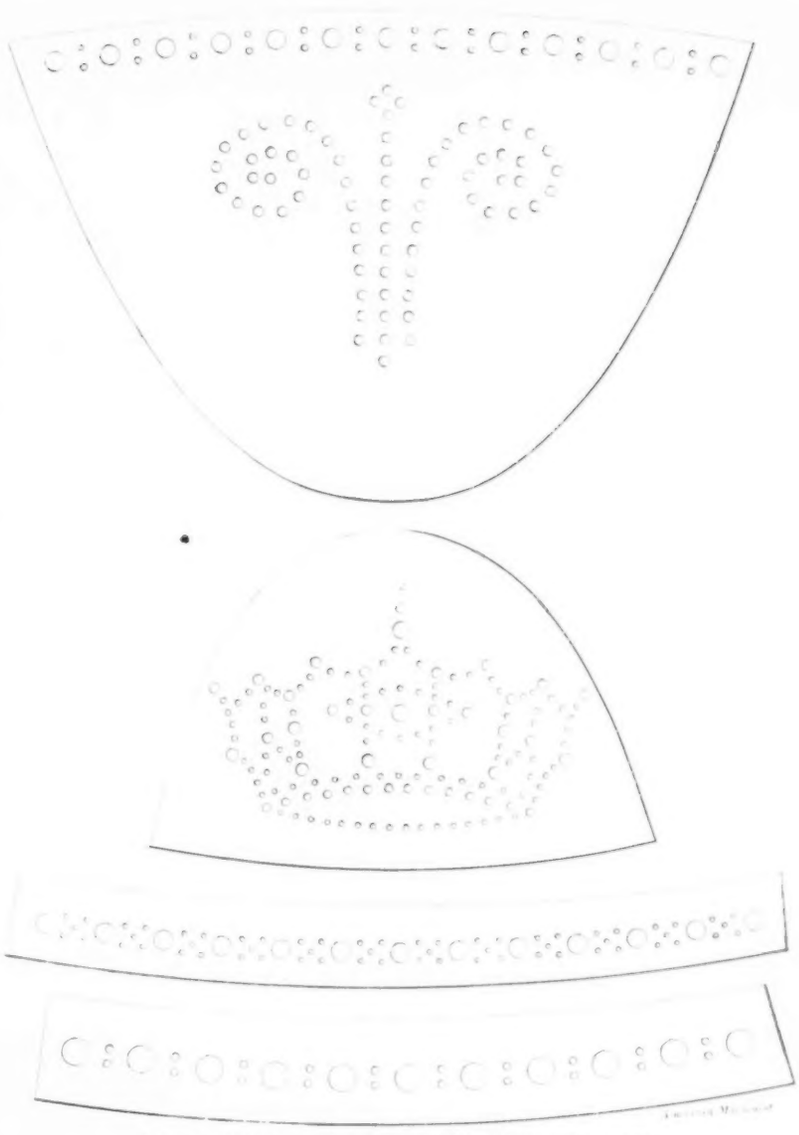


FIG. 1. SAMPLES OF LEATHER PUNCHING—FULL SIZE.

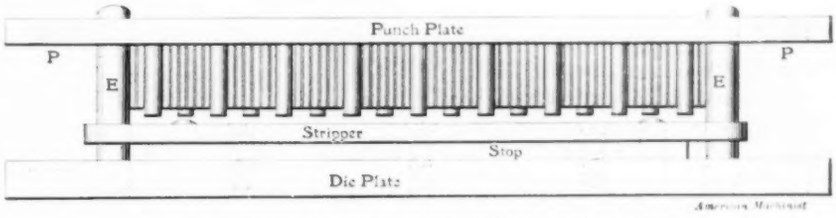


FIG. 2. FRONT OF LEATHER TIP PERFORATING DIE, COMPLETE.

The templet being finished, we fasten the stripper plate and the die together by the screws and dowels, and soft solder the templet to the stripper, so that the design will be in the position shown in Fig. 3, transfer the holes through it to the stripper, and drill entirely through it and the die, being sure to keep the drill sharp and using lard oil freely. After the holes have been drilled the templet is removed and the holes in the stripper are slightly countersunk at the top, while those in the die are reamed to a very slight clearance. The two holes *C C* are now drilled and slightly countersunk for fastening the die plate to the press bolster.

We now take another piece of steel and finish it to the same size and shape as the die plate for the punch plate, and after locating it true on the die we clamp it there and drill two holes at *E E* through both and ream them to 5-16 inch. These holes are for the punch and die alining dowels. The two dowels are made to the length shown and the ends are rounded. The pins are then driven into the holes *E E* in the die, and the two corresponding holes in the punch plate are reamed so that the plate will slide up and down on them without play. The punch plate is now located on the face of the die by means of the dowels, a pair of thin parallel

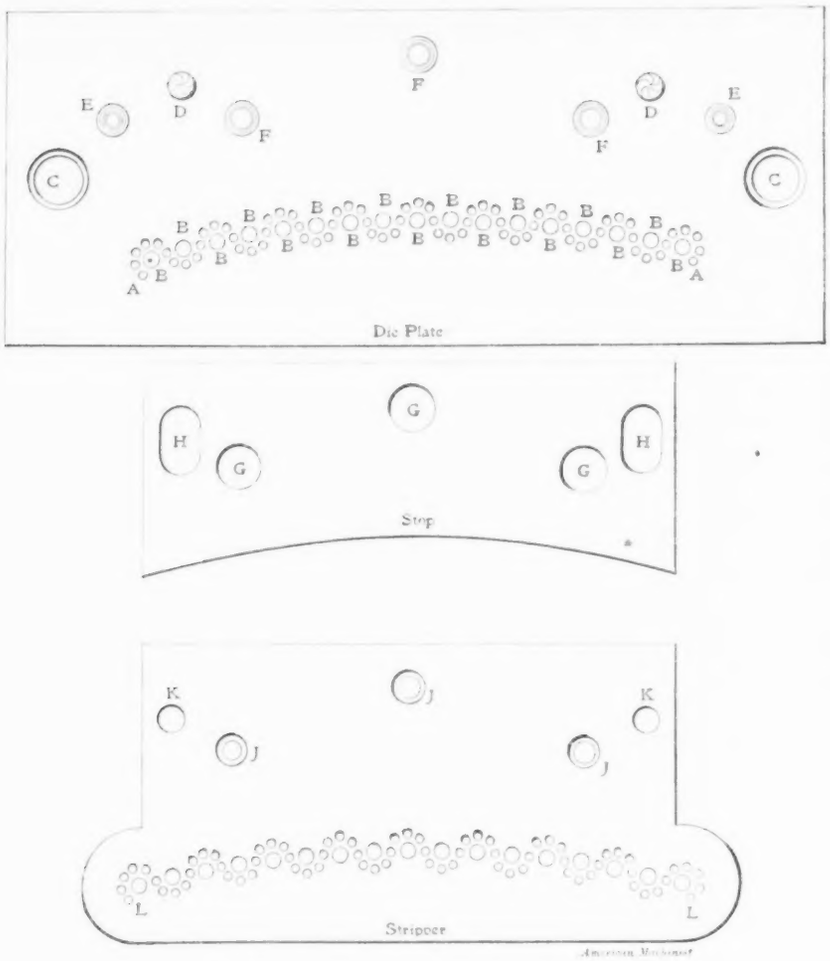


FIG. 3. PARTS OF LEATHER PERFORATING DIE.

strips are placed between them, and the holes are transferred through the die to the punch plate and drilled through. The punch plate is then removed from the die and the holes are countersunk at the back and a hole is drilled and tapped at each end for screws to fasten it to the press plunger.

The punches are made from drill rod of the correct size, are forced into the punch plate, as shown in Fig. 2, and upset at the back, first entering all the smaller punches and grinding them sharp and even with each other, by entering them into the die and allowing them to project through slightly and grinding them while thus supported. The larger punches are then fastened into the punch pad and ground in the same manner, leaving them about 3-32 inch longer, as shown. The stop plate, Fig. 3, is got out and finished to allow of adjustment, all the parts are assembled as shown in Fig. 2, and the die is complete.

In use the punch plate is fastened to the press plunger by a screw at each end, and the die-locating dowels *E E* are entered into their holes in the punch plate. The ram of the press is then brought down until all the punches have entered the dies, and the die plate is securely fastened to the press bolster. The construction of the dies in the manner here described insures

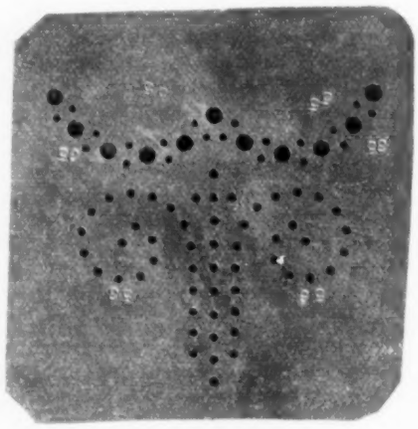


FIG. 4. A TEMPLET.

the perfect alinement of all the punches with the dies, and the dowels *E E* secure the setting of the punch and die in the press. For this work neither punches nor dies are hardened.

A Machine Shop Sermon.

An enterprising clergyman of St. Louis, Rev. Charles Stelzle, has been delivering a series of sermons upon topics connected with daily work in the trades. Some of the titles of these discourses have been: "The Drafting Room—Forming Life's Plans," "Pattern Shop and Foundry—Life's Models and Molds," "The Machine Shop—Life's Business," "The Switch Engine—Life's Humdrum Duties," "The Shoe Factory—Helping Along Life's Pathway," etc. We reproduce here a portion of the machine shop discourse. The matters of the shop seem to be handled with remarkable correctness, and without any of the absurdities or incongruities which usually occur in performances of this character. The discourse was accompanied by numerous lantern slides. It was, in part, as follows:

"The machine shop, with its manifold operations, presents a fine picture of life's business. Grinding, filing, cutting, fitting—all kinds of machines and all kinds of metals—it suggests the busy scenes of life, with all their vigor and variety. Here machines are built which seem almost human in their operations. They relieve man of the monotony of detail, so that he can give his time and thought to the higher things in life. Instead of a man wearily chipping away at a rough casting, the chisel operated by compressed air takes the places of four men. Instead of a man slowly setting type by hand, the machine does the work four times as fast. Instead of a man working off a few thousand copies a day on a hand press, a modern press will print 200,000 four-page newspapers in an hour. All this and much more the machine shop has done for mankind. It has given him the engine and the locomotive, so that his strength has become that of the giant and his speed that of the wind.

"And the men who have built these machines are human benefactors. You may serve God and man in the shop as well as in the study. You can serve by putting your soul into a machine as well as by putting it into a meeting. The lawyer, adjusting a dispute, the physician healing the sick, the teacher preparing for life's duties, the mechanic doing reliable work which will stand the test of time, are serving God as truly as the missionary and the preacher are serving him. Jesus Christ 'pleased God' as a carpenter. 'Whatsoever ye do, do it heartily, as to the Lord.'

"Men take the same kind of iron, worth $15 a ton, and they will work it into articles of different value: made into building columns it is worth $30; made into horse-shoes it is worth $80; into knife blades, $200; into watch springs, $1,000. Given the same talent, it is interesting to note how men use it. With many it is soon thrown into the scrap heap. With life wrecked, they have no future, either in this world or in that which is to come. Others spend it on themselves, and have nothing to show for it. Still others invest it in other lines, multiplying it a thousandfold.

"A mechanic who has a chest of forty tools and can use only hammer, chisel and saw, and these imperfectly, has little chance with his fellow-workmen, and soon

falls far behind. God has endowed man with forty faculties. All but three or four of them exist in him like unwrapped tools in a box, not even examined, much less named. And even the few are but poorly developed in many of us. The prophecy of Isaiah that men 'by hearing shall hear, and shall not understand; and, seeing, they shall see and shall not perceive,' is literally fulfilled in most men's lives. And it is all because 'their hearts have waxed gross,' as Jesus Christ put it.

"It is curious how men are influenced by the machines which they operate. I have seen stout men, who were naturally phlegmatic in their movements, become very lively by running a small, fast-speeding lathe, and men whom one would naturally suppose to be agile, would become as deliberate as the movement of their machine. A machinist using a chipping hammer, or an apprentice whistling a lively tune, will set the pace for the whole shop. Does not this suggest that we ought to surround ourselves with the most helpful and the most inspiring things, since we are so easily and so vitally influenced by them?

"Sometimes, in gaging a piece of work, two men using the same micrometer calipers will vary in their measurement to quite a degree. This is due to two things—fineness of touch and the temperature of the hand. The difference among men is largely a matter of temperament. The pale, sluggish, self-righteous man has little in common with the man whose body is a great physical engine, full of blood and nervous energy. But if the spirit of that sluggish man could, by some process, be transferred into the body of the one who is full of life he would find himself swept along as by an irresistible current, and there would come into being passions and desires which he never dreamed the human will could resist, and yet the man whom he so freely condemned has been fighting them with all the strength that God has given him. And so we need to have the largest charity for others, especially for those who are totally different than we are. Jesus Christ was unique in this charity.

"Stopping a machine before a job has been finished has sometimes resulted in a difference in the appearance and the finish of the piece of work. And so, when an important job is to be done, the same man will complete it without any stoppage. This makes him alone responsible for the job. God deals with you and me in the same way. We alone are responsible for the way in which we perform our life's work. But we are responsible. We cannot evade giving an account for the deeds done in the body. A mistake in the building of an engine may be rectified, but how can you replace the scrap material put into your life ten years ago? Some day there will be a crash, and what appeared to men to be a beautiful life will prove to be a sham. The engine will at last wear out and go to the scrap heap; but there is no scrap pile for the soul. How then are you building? What kind of material are you putting into your life?"

A Machinist Apprentice System for the Navy.*

BY LIEUT. T. W. KINKAID, U. S. N.

In the naval service technical difficulties are not the only ones that confront the chief engineers of our ships. No matter how high his professional and executive ability, the officer is hopelessly handicapped if he have not the proper men to do his bidding. Firemen, oilers and water tenders can be trained from raw material in a reasonably short period; but machinists, of whom our larger ships require as many as twelve or more, are not to be had in sufficient number. A fine ship without a proper complement must be considered a "lame duck."

It is not surprising that young men with good shop training are not desirous of going to sea as enlisted men. The inducements in the matter of pay are not great, as the first compensation is only $40 per month. Even after a considerable lapse of time, the machinist, second class, cannot be rated for higher pay unless a vacancy should occur on the ship to which he is attached. Finally, when, partly by virtue of merit and partly by lucky chance, he steps into a vacancy in the chief machinist rating, his pay is only $70 per month, which is little enough for a skilled man who gives up home comforts and associations, and has to perform much of his duty at night and on seven days of the week.

The establishment of the rank of warrant machinist has done something toward inducing good machinists to enter and remain in the service; but the number of such prizes is limited, and the efficiency of warrant rank as a drawing card is limited correspondingly.

I have always thought that one of the most potent causes of discontent among the enlisted men, especially the intelligent men in the higher ratings, has been the utter lack in naval regulations of any provision for their shore duty. Going to sea, with occasional liberty in domestic and foreign ports, may constitute a satisfactory career in the eyes of the younger men of the service, but there comes a time in the life of every man before the mast when continuous sea duty becomes monotonous. At this juncture many good men fail to re-enlist, and, having once obtained a footing on shore, they remain permanently out of the navy. Matrimony plays a prominent part in taking men from the service. It is natural, of course, that men should wish to marry, but without shore duty married life is practically impossible.

The question, "What shore duty would you give these men?" is easily answered. Most of the machinists on shore duty could be profitably employed at our navy yards, in the shops and on ships under repairs; others would be extremely useful as assistants to inspecting officers at shipyards, steel works, ordnance factories, and so forth. Those employed at navy yards should have quarters in barracks; those on detached duty should receive commutation for quarters and rations.

Even if the allurement of shore duty were offered, I believe that there would still be a dearth of machinists; and I am satisfied that the most practical method of supplying the deficiency would be through the agency of a properly organized and administered apprentice system. I believe that we should take in our men as we do our officers—while they are young. It is a well-known fact that under the old apprentice system trades were but slowly learned, because frequently the master had a selfish interest in retarding the advancement of his pupil. But it is safe to say, I think, that a system could be organized within the naval service that would give us well-qualified and well-disciplined young mechanics, fit for any machinist duty, afloat or ashore, at the end of three years of training.

Assuming such a system in existence and the period of enlistment on probation as four years, the age limits at enlistment we may take at seventeen and nineteen years. The machinist apprentice should spend his first year at a navy yard on the Atlantic or Pacific coast. The apprentices should be quartered in barracks. They should be divided into sections of about twenty boys each. The instruction at each yard selected for apprentice training should be under the supervision of a commissioned officer, assisted by two warrant machinists especially selected for the duty. A scheme of instruction and discipline, prepared under the supervision of the Bureau of Steam Engineering, should be incorporated in the navy regulations. An approved glossary of technical terms as used in the navy should be prepared for the instruction of the boys. The rating for the first year of service would be machinist apprentice, third class, and the pay might be put at $16 per month.

In order to give the young apprentices healthful recreation within the limits of the navy yards, the barracks in each instance should adjoin a gymnasium equipped with the usual apparatus, and including baths, swimming tank and bowling alley. There should also be provided a reading room supplied with trade papers and other reading matter. The expense of the reading room equipment should be borne by the apprentices.

Should the machinist apprentice be retained in the service for a second year of instruction he should be given the next higher rating and the pay of $30 per month. The second year should be spent at sea in the performance of the duties of oiler and machinist's helper. Machinist apprentices at sea should be in excess of complement.

The third and final year of instruction

*Journal of the American Society of Naval Engineers.

should be at a navy yard, with the rate of machinist apprentice, first class, and pay of $40 per month. The rate of machinist, second class, should be abolished, and machinist apprentices, first class, should, after a year in their rating, be eligible for promotion to the rate of machinist, with pay of $70 per month. Chief machinists should receive $80 per month.

Quarterly reports as to aptitude, industry and general conduct should be made to the department, and apprentices falling below the standard should be summarily dropped.

I have not outlined a course of instruction for the apprentices at navy yards. There are many officers in the service who are well qualified to devise a course in the machine shop, foundry, pattern shop, and so forth, and such a program would doubtless be forthcoming at short notice if required. Some instruction in the coppersmith's art would increase the all-around usefulness of the young machinist.

Finally, I think it is axiomatic that the more good men we get and retain in the service the more attractive will it become to the good men outside.

The Eye and Its Care.

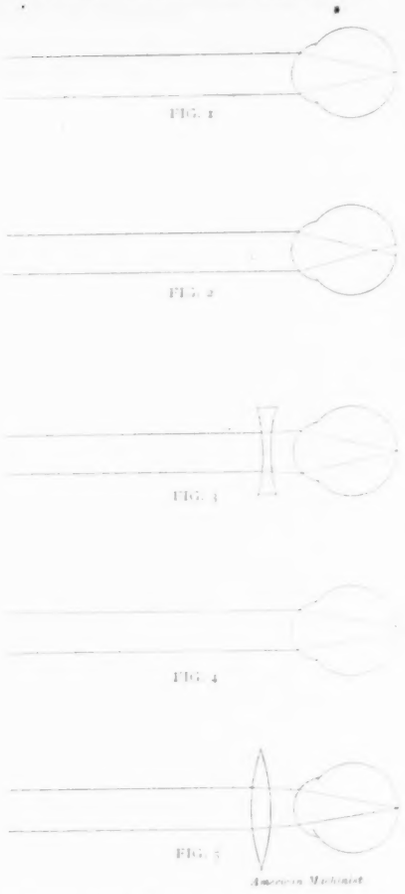
BY C. RIDDERHOFF.

An article recently appeared in these columns in which mention was made of mica and celluloid goggles for protecting the eyes against the entrance of foreign matter. Although the usefulness of these goggles in some classes of work cannot be denied, it is well to consider them as a more or less necessary evil and not to wear them unless flying grit, dust or sparks render their use necessary.

The principal reason why their use should be avoided is that they check the free circulation of air along the eye and deprive it of the cooling effect of this. Heating of the eyes, if they are at all delicate, is to be avoided by all means and will often do more harm than the occasional entrance of a bit of foreign matter.

To this objection may be added that both mica and celluloid are so soft that, when grinding, nearly every particle of grit striking the surface becomes partly imbedded therein, and the first time an attempt is made to wipe them some of this grit is loosened by the cloth and by scratching the surface seriously impairs the transparency. The result is that the protection soon becomes more of a nuisance than the evil it is intended to guard against. It would seem possible to produce a frame so constructed that the mica lights as they became dull could be readily replaced by new ones, but I have failed so far to find such in the market.

It is because of the heating of the eyes and the short-lived transparency of these protectors that, for machine shop use at least, I much prefer ordinary glasses, which, though they do not offer quite so much protection against dust *floating* in the air, will effectually prevent anything striking the eye with sufficient force to imbed itself in the cornea or sclerotic.



NORMAL AND DEFECTIVE EYES AND THE CORRECTION OF DEFECTS.

The lenses should be quite large, what is known by opticians as the O O eye size, and the frame so formed that the lenses will be far enough from the eye to allow loose particles to be removed from the lids with the tip of the little finger without removing or soiling them. The lenses will then usually be far enough forward to prevent drops of sweat trickling over them from the forehead. The form of the lenses, for the normal eye, should be plano, and it is well to use a good quality. I have seen cheap lenses with surfaces so irregular as to cause artificial astigmatism, and that such are trying to the sensitive eye needs no proof.

The question of the form of lenses, other than plano, that might be used naturally leads to a thought concerning the eye itself, viewed as an optical instrument and as its action is but little understood, a little information concerning it may not be unwelcome.

It would appear as if, in our business especially, where the eye is the principal connection, so to speak, between the mind and the work, it should receive more attention than it does.

When a draftsman has bent over his table, or a machinist has watched the fine lines on the surface of a die all day long and the eyes feel hot and as if they were under pressure, there is little thought of the enormous amount of work that has been done by this little organ, and when, during the evening's study, they refuse to be further abused, and that sandy feeling causes the lids to close, they are rubbed or wetted in an effort (though unintentional) to ruin them entirely. It has been said that the eye can consume more nerve-force (the steam of the human plant) than any other organ, and although there has not yet been established a standard of measurement for this force, I do not think the statement very far from true.

The eye is, as has often been shown, an optical instrument very similar to a camera, the principal difference being that normally it is self-focusing (with apologies to the makers of cameras with *universal* focus lenses) and that the iris diaphragm is perfectly automatic in its action, so that when directed to an object it immediately adjusts itself, so that a clear and well-defined image is projected on the retina, the iris taking care that the pupil is of a size corresponding to the amount of light or the sensitiveness of the retina.

While in a camera the proper focal distance is obtained by changing the distance between the lens and the screen upon which the image is to be projected, this is not so with the eye, the same result being there produced by a change in the convexity of the crystalline lens. This lens is soft and surrounded by a muscle (the ciliary) which contracts or relaxes according as the object seen is nearer or farther away.

In the emmetropic or normal eye the distance of the retina from the lens is such that when the ciliary muscle is entirely relaxed parallel rays of light will focus at the retina, so that when looking at distant objects there is no work performed by this muscle. Opticians consider rays coming from a distance of 20 feet or more parallel. In reality they are not; in fact, absolutely parallel rays do not exist in nature, but as the angle between rays of

FIG. 6. TEST OBJECT FOR ASTIGMATIC EYES.

light entering, diametrically opposite each other, a pupil 3-16 inch diameter from 20 feet distance is less than three minutes, they may for this purpose be considered parallel.

It is in the variation from the normal eye as regards the distance of the retina from the lens in relation to its refractive power that consist the errors of refraction for which glasses are usually worn. The three errors, of which combinations of any and all may exist in the same eye, are: Myopia (nearsightedness), hypermetropia (farsightedness) and astigmatism, for which there seems to be no popular name. I will not attempt to go fully into the details of these conditions, as to do so would fill a volume, but to explain of what these errors consist and what effect they have upon the acuteness of vision may be beneficial to some who think their eyes are "just weak," but who are in reality suffering from the defects of refraction, wholly correctible by the use of properly formed lenses. Especially among machinists and draftsmen there are undoubtedly some who would wear glasses if they knew what benefit is to be derived therefrom, and who are kept from doing so partly because (often not without cause) distrusting the average optician, and partly on account of a dislike for the wearing of glasses. I have often thought it would be well if an equalization could be effected between these and some of the ladies who wear pince-nez for appearance only.

The outline of the normal eye and the path of rays of light entering are shown in Fig. 1, where parallel rays focus at the retina.

Fig. 2 shows a near-sighted eye. The distance of the retina from the lens is too great and the rays of light come to a focus in front of the retina, then cross and form a blurred image of the object seen. If the reader is not nearsighted he can make himself artificially so by holding a strong convex lens before the eye and looking off in the distance. Could the convexity of the lens in the eye be decreased, its focal distance would increase and the image on the retina might be made clear, but after the ciliary muscle is entirely relaxed there is no further means for doing this, so that there is no alternative but a concave lens must be worn to render the rays divergent before entering the eye. This has the same effect, and with a lens of the proper strength the error may be entirely corrected, as is shown in Fig. 3.

Fig. 4 represents a farsighted eye. The retina is too close to the lens and intercepts the rays before they have come to a focus, so that as in the nearsighted eye a blurred image would be the result, were it not for the fact that the ciliary muscle will increase the convexity of the lens, thereby shortening its focal distance and rendering the image clear. It is because of this that the farsighted eye is usually left uncorrected by glasses so much longer than a nearsighted one, the thought evidently being that as long as the acuteness of vision is not impaired, the eye is all right optically. It will be plain to the intelligent, however, that an eye in which the ciliary muscle is under tension for at least fifteen hours each day cannot but be injured by this strained condition. The amount of nerve-force required for this is excessive, and on account of the close proximity of the eye to the brain, serious results are, in extreme cases, to be feared. Suppose your arm could be in a condition that would cause the muscles to be under a strain the same as when lifting a weight, even when hanging loosely by your side, can it not easily be imagined that on account of this constant tension the arm would become terribly fatigued? To be sure, the ciliary muscle is very small compared with the muscles of the arm, but no smaller in comparison with the work it has to do, so that the effect of straining it is just as pronounced. To correct farsightedness evidently requires the opposite treatment of nearsightedness. A convex lens of the proper strength placed before the eye will render the rays convergent before entering and cause them to come to a focus correspondingly sooner after passing through the lens. This is illustrated in Fig. 5.

Astigmatism is a difficult condition to illustrate. In it the curvature of the lens is greater in one meridian than in another, so that there is no focal distance, but the rays passing through at one meridian—the horizon, for instance—may come to a focus at the retina, while those passing through the vertical meridian may focus either in front or behind it. It will be clear that for its correction a lens is required which is curved more in one direction than in another. The existence of astigmatism can be detected by looking, with one eye at a time, at the radiating lines in Fig. 6, in which, if it exist, some of the lines will appear blacker than others. Near-sightedness can scarcely exist unknown, as its effects are too evident, so that no special instructions are required for detecting it; but farsight, which, as before explained is hidden by the action of the ciliary muscle, does not show its existence except through symptoms of fatigue in the eyes, headache or inflamed eyelids, the acuteness of vision rarely being below the normal. The existence of farsightedness can be proven by looking through a convex lens at a distant object with sharp, clear outlines. If the sharpness of the object is not reduced, it is sure to exist, and even if the outline of the object should become blurred it is not necessarily a sign that there is no hypermetropia; for, especially in young people, the ciliary muscle is sometimes, through being constantly strained, affected with a spasm which would cause the eye to appear normal, notwithstanding the error. Opticians have means to detect and develop errors which would not show otherwise, and when the eyes show any symptoms of trouble they should be carefully tested with the proper instruments.

In the foregoing the crystalline lens alone has been considered for the sake of convenience, though in reality there are several substances which together form what is termed the refractive or dioptric system. The light entering the eye passes successively through the cornea, the aqueous humor, the crystalline lens and the vitreous humor. The latter fills the whole eyeball back of the lens, and it is in this substance the small opaque particles float which give rise to the seeing of specks and beads.

Even the normal eye is not always equal to the demand made upon it by continual near work and can often be assisted for such work by wearing convex lenses. The extreme convergence of the eyeballs can be relieved by combining these convex lenses with prisms, worn with the apex of the prisms outward.

In conclusion, take good care of the eyes, no matter what their condition, and if you wear glasses and know that you need them, don't believe Christian Scientists who tell you you do not. Work neither by a dim light nor in direct sunlight if it can be avoided; both extremes are injurious. Avoid the angle of reflection when reading and keep your book not less than 14 inches from the eyes, also keep the head as near as possible to an upright position. The latter especially should be heeded; stooping over book or work is far too common, and the pressure of blood it causes in the eye has often produced what is known as acquired myopia, and while the other errors of refraction, including congenital myopia, are deformities and not diseases, this cannot be said of acquired myopia, for it is a disease, usually progressive and much to be feared.

When the eyes feel tired at night a good bathing in bloodwarm soft water will cause the overstrained muscles to relax and relieve that feeling of tension greatly, assisting the enjoyment of a sound sleep and a better condition in the morning.

Marking Blueprints.

It has become the custom to use a soda solution, using it as ink, and the result is a white line not very different from the print. The soda on the surface of the paper collects dirt and the lines fade and lose their original intensity. The right way is to write your figure in ink—ordinary Carter's or any other fluid that is acid proof—then take your ruling pen and put a blot of soda over the spot. This whitens the background and turns the ink jet black, and it is done in half the time and twice as nicely as any other way. The white spot is there to stay and the ink will never fade.—*The Draftsman.*

"And now what do you propose to take?"

"Mechanical engineering."

"But is not that profession somewhat overcrowded?"

"I believe it is, but I shall study it just the same and those who are already in the business must take their chances."—*The Draftsman.*

The Reading of Verniers.

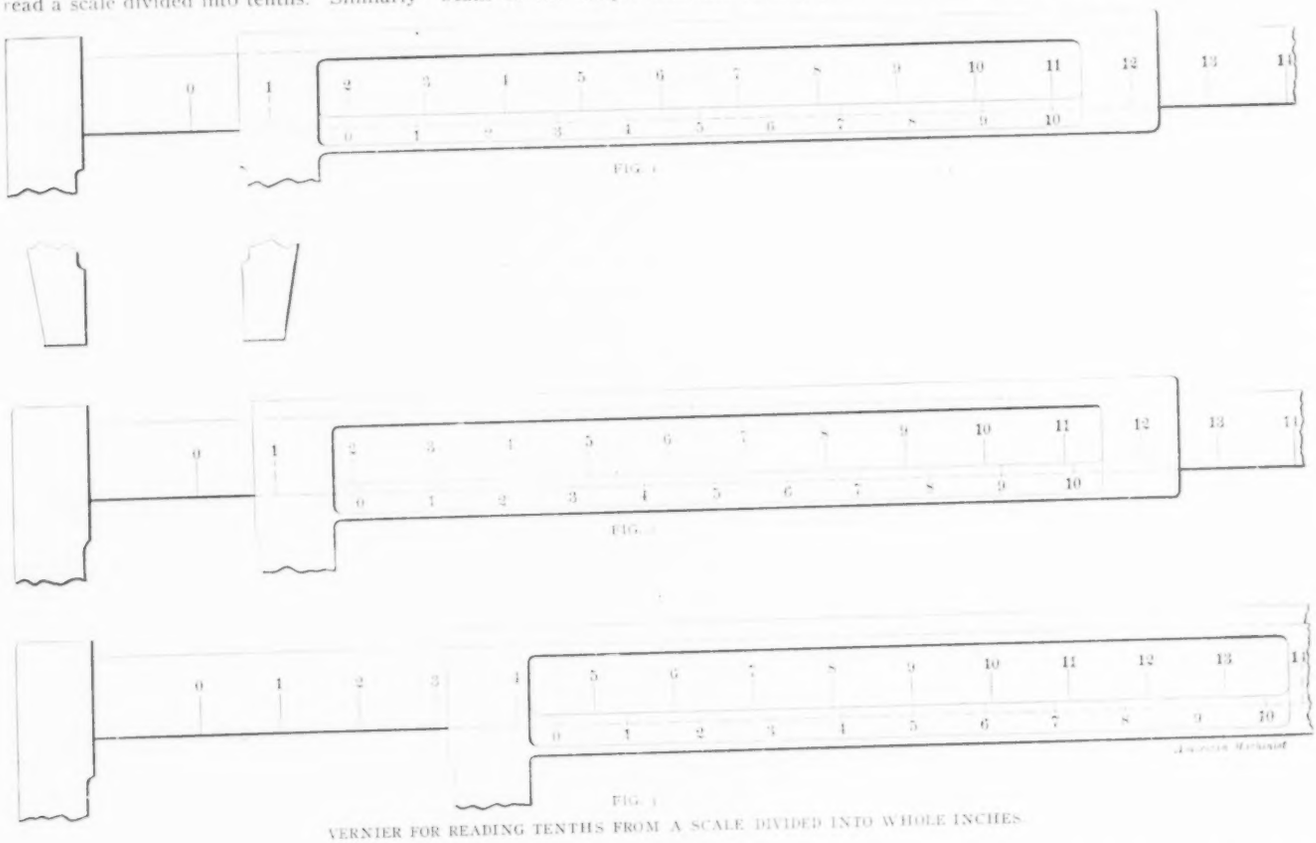
It has been suggested to us that the use of verniers as applied to calipers is not as well understood as the merits of the instrument make desirable, and that an article explaining the reading of verniers would prove useful.

The object of the vernier is to enable fine readings to be obtained from a scale having coarse divisions. As often made, the readings are ten times as small as the divisions of the scale, though verniers may be, and often are, made with other ratios. Using the ratio of ten, a vernier may be made to read to tenths of an inch from a scale which is divided into whole inches only. There would be no advantage in this, however, as it is perfectly easy to read a scale divided into tenths. Similarly a scale divided into tenths may be read to hundredths, and here the advantage of the arrangement begins to appear as, while a scale divided into tenths may be read with perfect ease, one divided into hundredths requires some effort by the eye.

If the process be carried a step further, the advantage of the vernier is very apparent. A scale divided into thousandths could not be read without a glass, but by means of a vernier thousandths may be read from a coarser scale. This coarser scale may be divided into hundredths and the vernier be made to divide these divisions by ten, but such an arrangement would not be very desirable as a scale divided into hundredths is already pretty finely divided to read without a glass. As has already been said, the vernier may be made to divide the beam readings by any number and by using a larger division than ten the beam divisions are made coarser, as will be more fully explained further on.

For the purpose of explanation a vernier for reading tenths from a scale which is divided into whole inches is probably better than a finer one, though no one would think of actually making such a vernier. The size of our page prevents showing such a vernier full size, and Figs. 1, 2 and 3 are therefore drawn to reduced scale, but the divisions of the beam are to be considered as inches. To make the illustrations more realistic, the fixed and sliding jaws of a caliper are sketched in.

The inch divisions are shown upon the beam of the caliper and the sliding jaw is made so long that its open side will a little more than span 9 inches of space. Upon the beveled edge of the sliding jaw two lines 0 and 10 are shown, these marks being at a distance apart which covers *nine* inches on the beam, these nine inches being then divided into *ten* equal spaces forming the vernier, each space of which obviously equals 9-10 of an inch. The caliper in Fig. 1 is shown set with the 0 mark of the vernier coinciding with the 2 mark of the beam and the jaws are therefore open by 2 inches. This 0 mark of the vernier is read precisely as though the other divisions of the vernier were not there. If set at 3, the caliper is open by three inches, and so for any other division. Comparing 1 of the vernier with 3 of the beam, it is clear that as space from 2 to 3 of the beam equals 1 inch, while the space 0—1 of the vernier equals 9-10 inch the space between 1 of the vernier and 3 of the beam equals 1-10 inch. Similarly space 2—4 of the beam equals 2 inches and 0—2 of the vernier equals $\frac{9}{10} \times 2 = \frac{18}{10}$ inch, and hence the space between 2 of the vernier and 4 of the beam equals 2 less 18-10, or 2-10 inch. In the same way the space between 3 of the vernier and 5 of the beam equals 3-10 inch, the space between 4 of the vernier and 6 of the beam equals 4-10 inch, and so on. Moreover, these readings of the vernier do not depend upon which beam division the 0 of the vernier rests. With the vernier zero set at any graduation the number of tenths by which any mark of the vernier falls short of the division of the beam next past it is always given by the number of the vernier division. Now, if the space between 1 of the vernier and 3 of the beam is 1-10 inch, it is only necessary to slide the jaw along, as in Fig. 2, until 1 of the vernier matches 3 of the beam to make the vernier read 2 1-10 inches. Similarly as in Fig. 3, if the jaw be slid along until 0 of the vernier has passed 4 of the beam and 5 of the vernier matches 9 of the beam the reading is 4 5-10 inches. To set the vernier for any reading, as for instance 6 7-10 inches, it is only necessary to slide the jaw until 0 of the vernier is at 6 and then slide it further until 7 of the vernier coincides with one of the beam divisions. As 1 of the vernier passed 7 of the beam, the reading was 6 1-10, as 2 of the vernier passed 8 of the beam the reading was 6



VERNIER FOR READING TENTHS FROM A SCALE DIVIDED INTO WHOLE INCHES.

2-10, as 3 of the vernier passed 9 of the beam the reading was 6 3-10, and so on until 7 of the vernier reaches 13, when the reading is 6 7-10. Similarly if the vernier has been set by applying it to a piece of work, it is read by first noting the last whole inch of the beam which was passed by 0 of the vernier, and then glancing along the vernier until a division is found which coincides with a mark of the beam, when the number of that vernier division will give the number of tenths to add.

In making calipers to read to thousandths it is desirable to avoid so fine a beam scale as one divided to hundredths, and to do this the Brown & Sharpe Manufacturing Company divide the beam to fortieths only and then use a vernier with twenty-five divisions. Following the above rule gives $\frac{1}{40} \div 25 = \frac{1}{1000}$ as the vernier reading.

Fig. 4 shows the Brown & Sharpe vernier to an enlarged scale, and it will be easily understood after what has preceded. The inch will be seen to be divided into

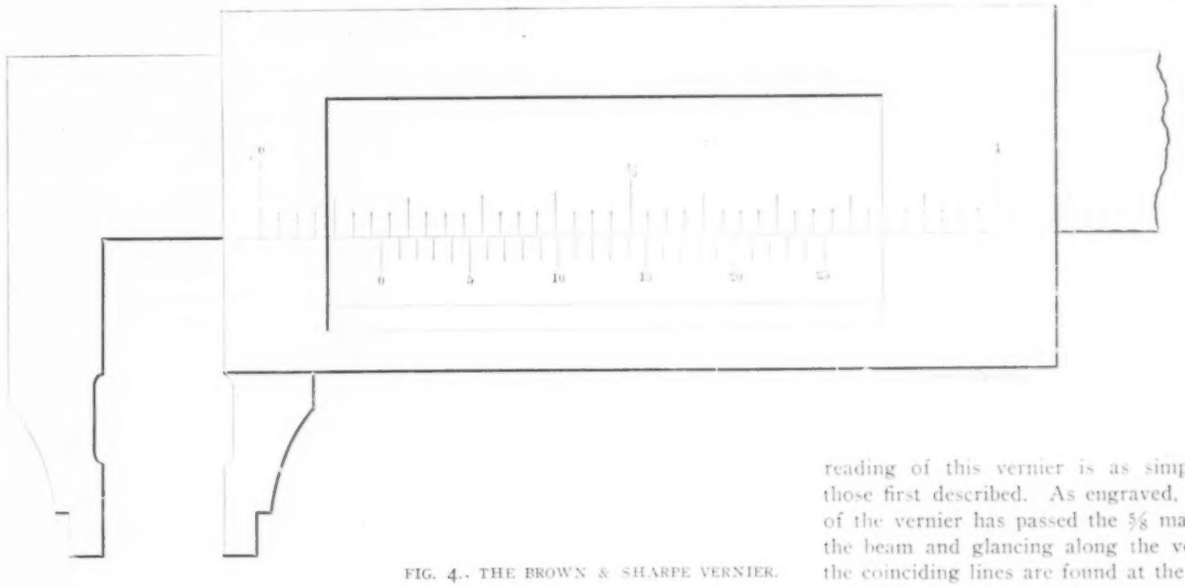


FIG. 4.. THE BROWN & SHARPE VERNIER.

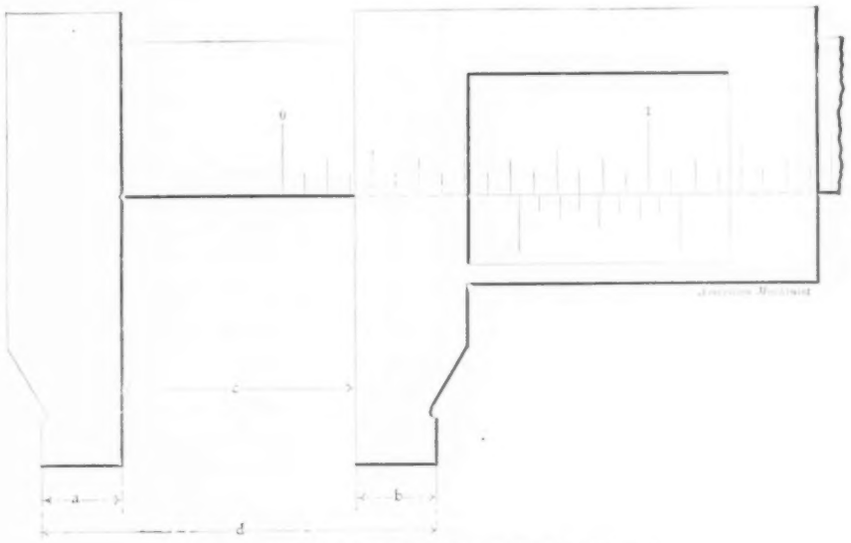


FIG. 5. THE VERNIER OF THE COLUMBIA CALIPERS.

tenths and each tenth into four parts, the value of each part being obviously 1-40 or .025 inch. Twenty-four of these parts are then divided into 25 spaces on the vernier. In the illustration the 0 of the vernier has passed the first tenth and the second subdivision. As the value f each subdivision is .025 the value of two of them is .05, and if the zero of the vernier stood at the second division the reading would be .1 + .05 = .15. To find how many thousandths must be added to this for the setting shown, we run the eye along the vernier and find that coincidence between the divisions of beam and vernier occurs at the twelfth division of the latter, which gives 12 thousandths for the addition. Making this addition we have .15 + .012 = .162 as the reading.

E. G. Smith, of Columbia, Pa., makes a vernier caliper in which the beam is graduated to sixteenths and the vernier has eight divisions. The reading is therefore $\frac{1}{16} \div 8 = \frac{1}{128}$ inch. This caliper is shown in Fig. 5, again to an enlarged scale. The reading of this vernier is as simple as those first described. As engraved, the 0 of the vernier has passed the $\frac{5}{8}$ mark of the beam and glancing along the vernier the coinciding lines are found at the third graduation, and the reading is therefore $\frac{5}{8} + \frac{3}{128}$.

This caliper has a very ingenious arrangement for direct reading when calipering a hole. The widths of the jaws *a* and *b* are such that together they are equal to the length of the vernier—that is 7-16 inch. This being the case, while the extreme left-hand graduation of the vernier gives the distance *c*, the extreme right-hand graduation gives the distance *d*, the value of the vernier readings being, however, obtained by counting from the left in both cases. It is obvious that if the left-hand graduation stood at $\frac{5}{8}$ the right-hand one would stand at 1 1-16, these being the measurements for plugs and holes respectively. Advancing the jaw to the position shown affects both readings alike and while the plug measurement is $\frac{5}{8} + \frac{3}{128}$ the hole measurement is $1\frac{1}{16} + \frac{3}{128}$.

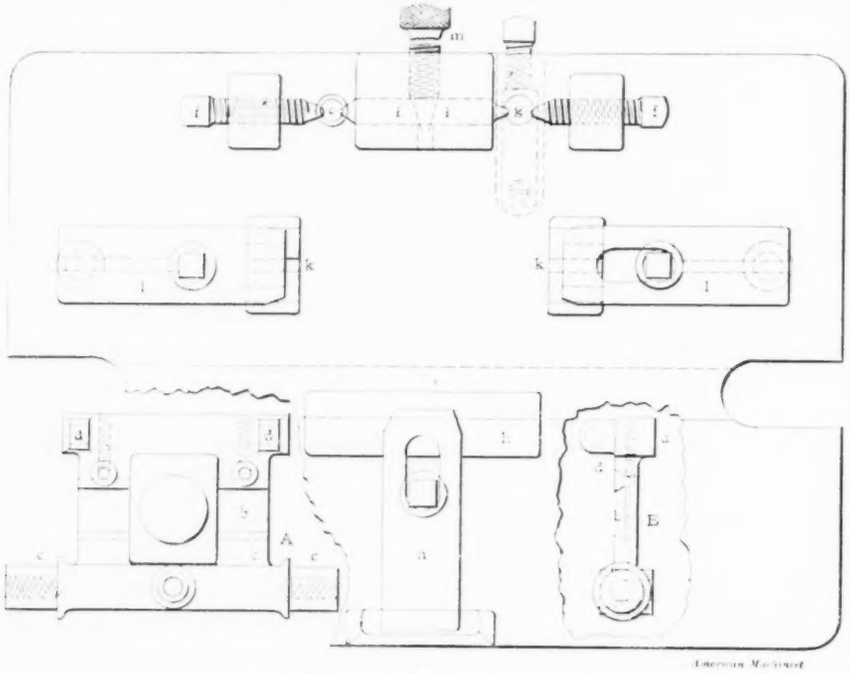
The State Department at Washington has issued, on some of its advanced sheets of Consular Reports, a description by Henry B. Miller, Consul at Niuchwang, of Dalny, the new Russian commercial seaport in North China and terminus of the Chinese Eastern Railway. The text is accompanied with numerous illustrations showing the processes by which this town was made to order. In point of interest the publication bears more likeness to a popular magazine article than to a Government report.

Letters From Practical Men.

A Jig for Two Milling Operations.

Editor American Machinist:

I think the milling fixture here shown is interesting, because it is a simple one to build, and is well adapted for taking the two cuts *a* and *b* for which it was designed. *A* and *B* are plan and end view respectively of the casting to be milled. It is a special one, and of such a shape that without some sort of a fixture it would be rather difficult to hold and have the cuts true and parallel with the turned ends



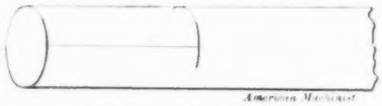
A JIG FOR TWO MILLING OPERATIONS.

at *c c*, and it is not in every case by any means that one fixture can be used for two operations. On the jig the raised portions *k k* of the casting have V's planed in them in line with the tongue on the under side. These are finished on the inside edges something wider between them than the length to which the shoulders are squared at *c c*, to allow the push pins *i i* to come in contact with both lugs *d d*. These V's and the straps *l l* serve to locate and hold that side of the work for both cuts. For the first cut at *a* the work is put into the V's and is pushed down until one of the lugs *d d* is in contact with *c*, the top of this pin having the right relation with the V's in hight. The inner ends of pins *i i* are reamed the same taper as the end of the knurled screw *m*. This screw is now run in until the ends of the pins it actuates are in contact with the two lugs *d d*, but not tight enough to spring the casting. Spring pin *g* is now allowed to come in contact with the other lug, locked screws are tightened, and we are ready for the cut. For the dovetail cut at *b* the work is reversed and *a* is laid on surface *h*, which is finished to the required hight, and the three clamps are tightened. The cut at *b* can be taken with a dovetail mill in a vertical machine, as with an attachment on a plain miller. The cut at *a* can be taken with either a vertical or a face mill. The under side of the fixture is recessed to make room for the spring which keeps pin *g* in contact with the work. MAC.

A Cheap, Quick Lap—A Kink in "Blue-Stoning" for Scratching.

Editor American Machinist:

A good way to make a lap quickly and cheaply is to take a piece of steel or brass tubing of the required diameter, and saw it about a third of the diameter through crosswise, about one or two inches from the end, then split it lengthwise into the cross slot. It can then be adjusted to suit the job. Of course, I know that this kind of a lap would not do for a very fine job



A CHEAP, QUICK-MADE LAP.

such as a ring-gage or similar work, but for drill-jig bushings and such work it is very satisfactory; if you don't think so, just try it. The sketch will show it clearly.

To obtain a coppered surface on brass or bronze, to enable you to see clearly lines laid out on it, dip the waste wet with the solution in cast-iron dust before applying to the surface to be coppered. Use the ordinary solution of sulphate of copper that is used for coppering steel.

A. H.

Reminiscences in Mill Work.

Editor American Machinist:

I remember among my first jobs in this country was the changing of a line of shafting which had what is called the Sellers coupling. These couplings had either been carelessly put on and had not been tightened up sufficiently to grip the shaft, or the shaft was out of line. They had worn the shafts a little and could not be tightened to make a good job. The boss in charge of the machine shop, which was in a woolen mill in the Province of Quebec, had been instructed to change the couplings and put on the common face couplings now generally used. Two lengths had been changed when I got a job in the shop. The work of changing had to be done at night so as not to stop the works. I was asked to help on this job. It usually took all night to get down a length, put on the couplings and set it back, the reason being that it took so long—four to six hours—to get the old couplings off, owing to the tapered piece on each end tightening up when driven either way.

I had never seen any such couplings in Scotland, and had to think what had best be done to get home sooner. We took out the three bolts which pull the tapered pieces together, took a sledge and gave the sleeve a few raps, and then drove a chisel into the slot of the tapered piece and kept the sleeve from gripping. In this way we had the shaft down in 45 minutes. I mentioned to the boss next day that it might be best to get a spare length ready to put up and so save night work. It took some persuasion, but, as we were getting time and a half for night work, we got the spare length and had things ready. In this way we made a change of one length every second night, starting at six o'clock and getting the whole work done by eight.

An every-day tool which came handy and useful at that job was a differential chain block. It required six men to handle the shafts. I got the blocks and made good use of them on that job and many others about the mill. I remember the first use of the blocks. When we got the shaft loose one of the men was hanging on the chain and calling for help. I asked him to let it go, and it was quite a surprise to all the men to see the shaft remain in the air. All this was thirty years ago, and yet I have seen similar work being done on shafting recently.

A. SANGSTER.

Sherbrooke, Que.

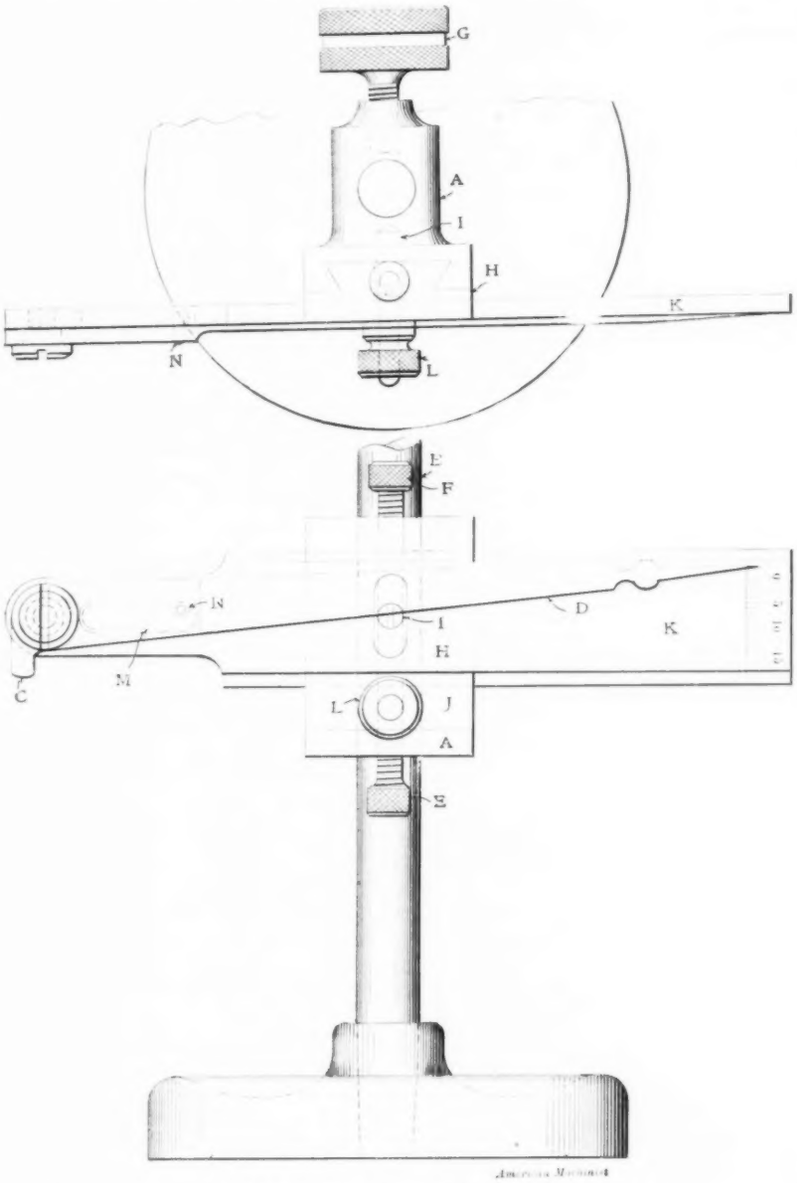
A Micrometer Surface Indicator.

Editor American Machinist:

The surface indicator shown in the accompanying drawing is, I think, about as good as any of its kind. It is strong, rigid and sensitive, as well as convenient, and will take in a large range of work. The main base and upright are the same as the ordinary surface gages, the slide *A* working up and down on the upright rod *B* until the point C on the indicator finger *D* comes in contact with the work, when the screw *G* is tightened, which holds the slide to the rod. Then the adjusting screw

F is turned down until the finger *D* shows on the zero mark, when the screw *E* is tightened, locking the slide *H* to *A* by tightening on the pin *I* which is screwed into slide *A*, slide *H* being slotted for adjustment up and down.

The indexed slide *K* can be moved back and forth in the slide *H* and is held by the gib *J* tightened by the nut *L*. The plate *K* is cut out, as shown, to receive the spring *M*, which has an eye for the pin *N*



A MICROMETER SURFACE INDICATOR.

which is fastened into the pointer in any convenient way.

This indicator is made and used by a well-known firm in Greater New York.

M. W. LEECH.

Cutting Bevel Gears With Spur Gear Cutters.

Editor American Machinist:

Requiring a pair of bevel gears for which we had not suitable cutters, the idea occurred to me to reduce the number of teeth sufficiently so as to get the space at the small end wide enough to use spur gear cutters.

The result has convinced me that there is little need of special cutters for this purpose—in fact, I think more satisfactory results can usually be obtained with spur gear cutters. The stout tooth they make being stronger, we can afford to lessen the length of face, and therefore if the length of face and the hight of tooth for a given pitch is lessened, the change in form towards the small end will be less, and consequently will require less doctoring with the file.

We have just made three pairs of bevel gears on this plan, and a description of one pair will be sufficient to explain the method. This pair has a pitch diameter of 4 inches for the small one and 7 inches for the large one. Both gears were shaped for and were cut with 6-pitch cutters; they were cut the right depth and on the same cutting angles as for 6-pitch, the only difference being to give them a less number of teeth, the 4-inch gear having only 16 teeth instead of 24, and the large one only 28 teeth instead of 42, consequently they are 4-pitch.

The length of tooth face is 1 inch, therefore the 6-pitch cutter is .033 inch thinner than the width of space at small end on the pitch line.

J. J. STEVENS.

Galt, Ont.

Pattern Repairs—Waxing.

Editor American Machinist:

Much time and considerable money are spent every year in most establishments in pattern repairs; a number of years spent in the pattern shop of a large foundry have proved that to me most effectually in one item at least, viz., the waxing of patterns.

Where the vent wire has left its marks, and in some cases mighty good sized ones from constant use, instead of wax I use plaster of Paris; and if it is applied in the proper way it will be found more durable, cheaper and quicker to apply than wax. Have the pattern brushed clean and apply a light flowing coat of yellow shellac, which will run in the holes and crevices, and allow it to dry. Take a block of wood 5x5x2 inches thick, bore a 2-inch hole 1½ inches deep, and you have your receptacle for holding and mixing your plaster. Fill two-thirds with plaster, pour in your shellac and mix until a thick paste is formed. It is now ready to apply. Work well into all vent holes and cracks, smooth all off, and allow 30 minutes to 1 hour to dry. Sandpaper what projects above the surface, and your pattern is ready for varnishing. You will be surprised at the finish and durability of your pattern, besides a big item in reduction of expense.

G. P. CAMPBELL.

A Job of Taper Turning.

Editor American Machinist:

Some five or six years ago, while I was working in a small shop, I was given a casting and a sketch (see Fig. 1) with instructions to finish the piece all over inside and out. As it was to be used for a pattern it was only necessary that it should be fairly smooth and of an even thickness.

The only lathe in the shop large enough for the work had no taper attachment, so I adopted the following scheme. First I found a piece of 2-inch shafting, about 4 feet long, having a flanged coupling *A*, Fig. 2, fitted to one end, the flange being drilled for four ½-inch bolts. *B* is a 2-inch collar with set-screw and having four 17-32 inch radial holes, these holes to receive the threaded ends of rods *C*. The next move was to make a good-sized center hole in the bottom of the casting, then to drill four holes through the bottom for bolting the flanged coupling to the inside. The arbor was placed in position and bolted to the work, and then arbor and casting were mounted in the lathe be-

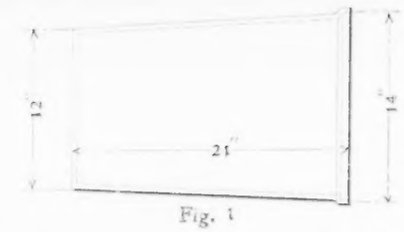


Fig. 1

Fig. 3

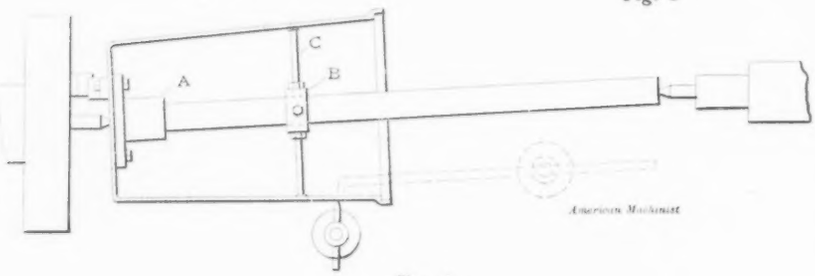


Fig. 2

A JOB OF TAPER TURNING.

tween the centers and driving in the usual way. The outer end was made to run true by placing shims between the flange and the bottom of the casting. The rods *C* were now placed in collar *B*, and the collar was shoved inside the casting about 6 inches from the mouth. The set-screw in the collar was tightened, a piece of paper was placed under the end of each rod *C* and the nuts on the same were screwed down on the collar, taking care not to spring either the shaft or the casting. Fig. 2 shows the work in lathe with the tail block set over the required amount for the taper. Fig. 3 is a view looking into the open end. The outside turning was then done, including facing the end as far as the bolts would allow, then a roughing cut was taken inside as far as the rods would allow. The collar was shoved in 6 inches farther and made fast as before, and the cut was carried in the additional distance. The collar and rods were removed and the cut was continued to the end and the bottom was roughed off as far as the flange would allow. Two finishing cuts were then taken over the casting without the supports; then the work was taken from the lathe, the arbor was taken out and the holes were plugged. The piece was chucked bottom out and finished on the end, then reversed and the bottom finished inside and the job was done. I have no record of the time taken on the job, only that it was longer than had been estimated. However, no fault was found and the work was satisfactory.

E. H. WRIGHT.

Threading Taps to Allow for Shrinkage in Hardening.

Editor American Machinist:

To allow for the shrinkage in hardening we are threading taps by the method explained at page 19, in which the taper-turning attachment and set-over tailstock are used in combination. We find, however, that the action of the dog when the tailstock is set over introduces an error. If the position of the dog on the shank is changed as from *a* to *b*, Fig. 1, we find that the tool removes the metal in places on the right and at other places on the left-hand side of the thread. The source of the error is plain from Fig. 2. The circular motion is changed to an elliptical movement, the axis of the ellipse being at those points where the shank of the dog meets the revolving pin. Therefore, the movement of the tap on points 1 and 7 is too slow and on points 4 and 10 too fast. Meanwhile the tool has a uniform motion, but this is so little that it is not of importance. Furthermore, if we put the dog at random on the tap shank, this introduces an additional and still larger error. Fig. 3 shows the nature of the error, the curved full line *a b* being the development of the actual thread, which should of course be straight. We should make the extreme position of the tail of the dog coincide with the dotted line through *e*, which will result in the smallest error possible with the arrangement.

OTTO ECKELT.

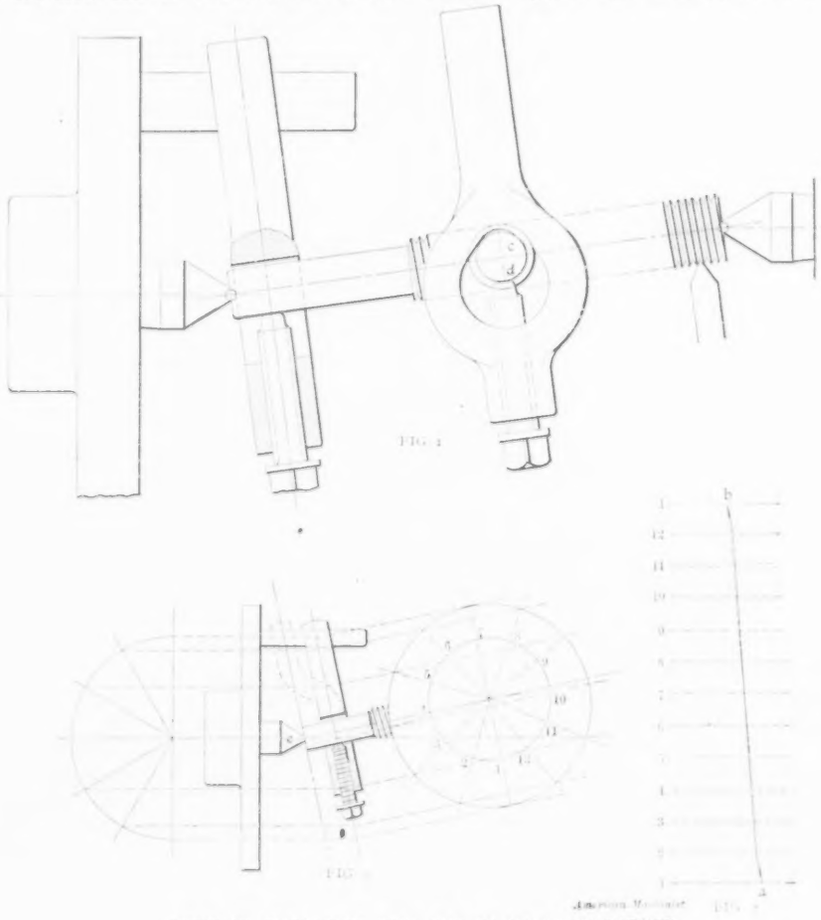
Berlin, Germany.

[With the tail of the dog on the dotted line through the center *e*, Fig. 2, the error is that due to an ellipse which is concentric with the circle. If the tail of the dog is located as shown by the full lines, an additional error is introduced, due to the circle and ellipse being eccentric to one another. In the second case a sort of Whitworth quick-return motion is added to the error due to the lack of circularity of the ellipse.—Ed.]

Molds for Babbitt Hammers and Vise Jaws.

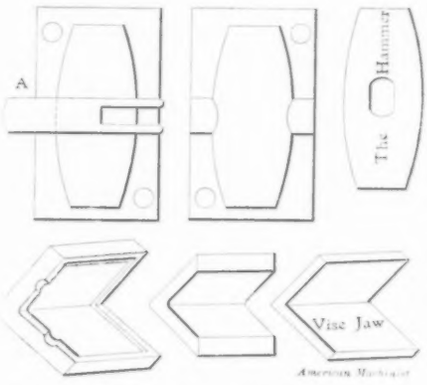
Editor American Machinist:

The sketches herewith for molds for babbitt hammers and vise jaws will require little explanation. The two halves of the mold for the hammer are shown with a steel core for the handle. The mold is clamped together and stood on the side *A*



ERROR IN THREADING TAPS DUE TO OFFSET TAILSTOCK.

when the babbitt is poured into the open end of the steel core. When the metal sets the core is driven through from the other end, shearing out the runner and leaving the hammer head clear. The vise jaw



MOLDS FOR BABBITT HAMMERS AND VISE JAWS.

mold will be understood, although it may be objected that the cast jaw will not come out of the mold. A little jarring of the mold on the edge *B* will bend the lip *a* down to clear the mold and then it drops out. This edge also may be beveled as indicated sufficiently to allow it to come out.

H. T. G.

Arrangement for Cutting an Odd Thread.

Editor American Machinist:

Here is a scheme which helped me out of a difficulty and might help some other fellow. I had a nut to make of brass, to fit a screw which was 1¼ inches diameter and had a square thread, 3 7-11 threads to the inch. Now, the nearest pitch I could cut with the gears on hand was 3½. I could have made one gear which, with those I had, would have given 3 7-12 threads, which I had decided to do, but before I got started I thought of this way.

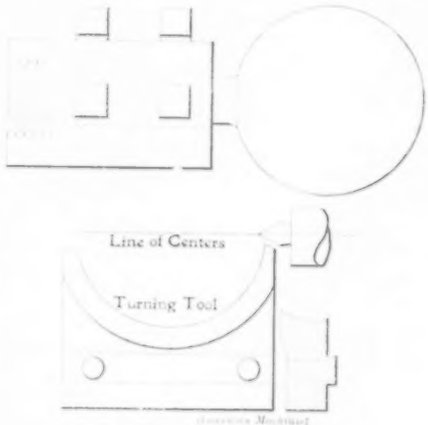
The photograph shows the lathe with compound rest and follower rest in place. It should also show the taper attachment, but I could only show the handle seen in the rear at the right. Anyone familiar with the Hendey-Norton lathes will recognize the outfit. To begin with, I took the compound rest and released the feed nut in it, so that the top slide was free to move independently of the screw. I then set this at an angle, as shown; almost any angle will do. Then I took a common wrought-iron hinge and riveted the joint a little, so that it would work fairly tight, and clamped this to the follower rest, so that when the lower part of the hinge was in the horizontal position it would touch the corner of the top slide of the compound rest and prevent it from moving crossways, as the taper attachment would naturally move it. Then, as the carriage moved along the taper attachment would draw the regular cross slide across and also the lower part of the compound rest; but as the top of the compound could not move across, on account of the hinge, it was forced to drop behind the regular feed of the carriage, which was 3½ threads to the inch, on account of the compound rest being set at an angle. Then, taking the screw which I had to fit the nut to and putting it in the chuck, with any old tool in the tool post, I adjusted the taper attachment so that the feed of the tool matched the pitch of the screw. I then took the screw out of the chuck and put in the nut to be threaded, and, putting an inside threading tool in the tool post, proceeded to cut the thread. After each cut through the nut I had to turn the horizontal part of the hinge so that it pointed straight down, and then I could move the tool back a little to clear the thread. On the return of the carriage before starting on the next cut, I turned the hinge to the horizontal position again, and saw that both the cross and the compound slides were in the same position as at the beginning of the first cut. This was necessary on account of the angles of the different parts; and for the same reason I could only set the tool deeper for each cut by tapping it around a little with a hammer. Of course, this job was not done at a record-breaking speed, but it was done in a reasonable time and much cheaper than by making an extra gear. The photograph was taken several days later, and shows the lathe just as arranged for the job but without the nut in the chuck or the tool in the tool post. The hinge I rubbed over with chalk, to make it show plainer. The jaw of the follower rest was dropped down and the hinge was clamped on to it by a thumb-screw clamp, as is partly shown in the photograph.

J. E. P.

Turning Governor Balls.

Editor American Machinist:

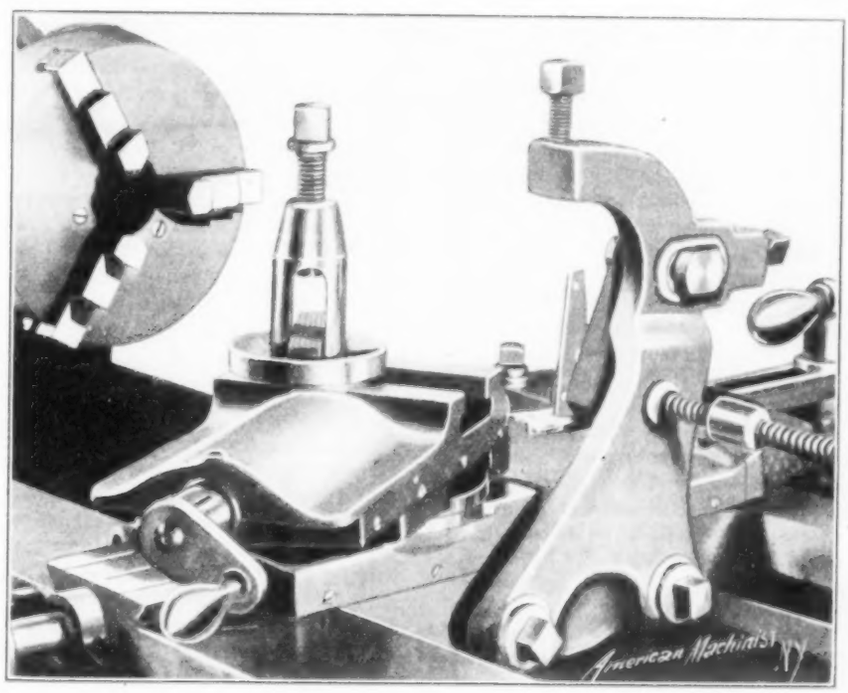
I have seen in your columns a good many special arrangements for turning balls, but I do not remember having read



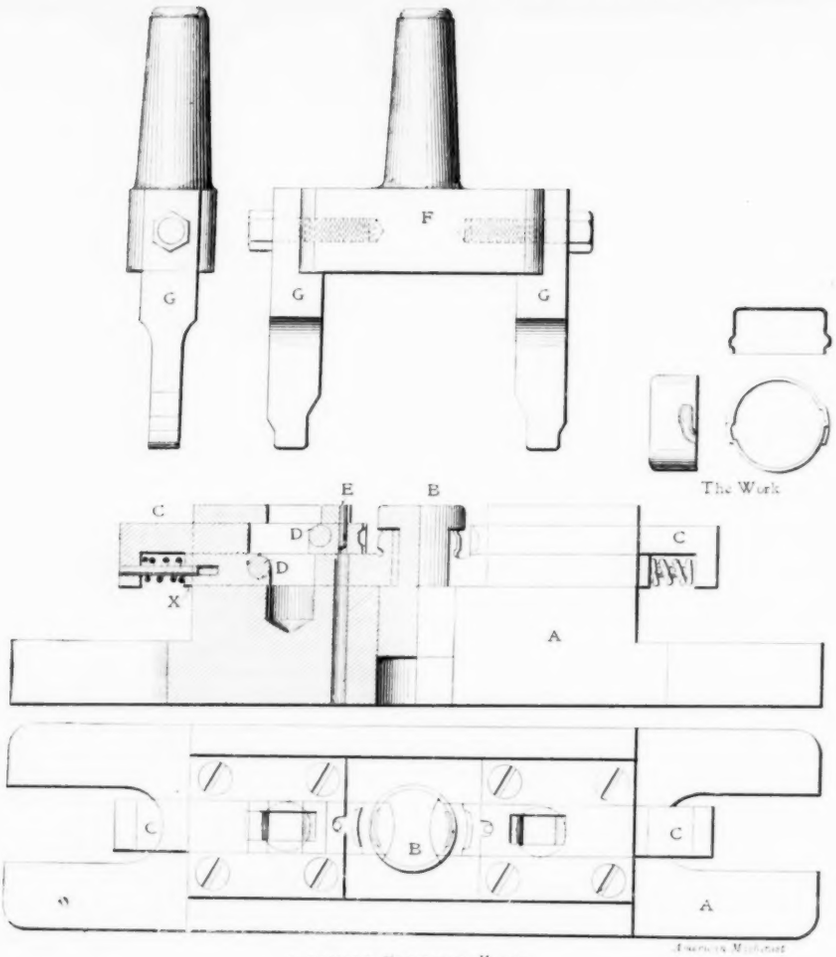
TURNING GOVERNOR BALLS.

any account of the most obvious and simple way, the forming-tool method. While a more accurate ball can be turned with some of these special jigs, a 6-inch governor ball which will caliper pretty close every way can be easily and rapidly made by this method.

The ball is cast with a strong shank and secured in the chuck by four ¾-inch set-screws, as shown. It is first centered and then roughed off to remove the scale. In roughing a curved surface like this, a round-nose tool of small curvature is best, because a considerable feed can then be taken without leaving very deep tool marks. This tool is fed by hand. Then the forming tool shown in the sketch is substituted for the tool-post. As the top of this tool is ground off in sharpening,



ARRANGEMENT FOR CUTTING AN ODD THREAD.



A DOUBLE "BUMPING" DIE.

paper is put under it. After turning the ball to size, a 1¼-inch hole is put through and it is cut off. A flat spot is finally faced at each end of the hole. A man could do a lot of fifty in from seventy-five to eighty hours. B. A. T.

A Double "Bumping" Die.

Editor American Machinist:

I send you sketches of a die for "bumping" both locks in a lamp tube. It has some points in it out of the common. The die is on the same principle as the double dies used for punching tubes. In bumping two locks in a lamp part it is usual to have the lower half of the die cut away, to allow the tube to be removed after the metal has been forced into the die. This trouble is done away with in the die here shown by mounting both the punch *X* and the die *C* on slides, so that as the drivers *G G* come down both dies are driven firmly together and as the plunger goes up both are withdrawn by the action of the springs, leaving the work free to be taken from the die post. A hardened steel roll is put into the slide to relieve the friction caused by the bumping process. The same style of die is used on other parts of the burner, the idea being the same. A. P. PRESS.

Truing a Slotter—Cutting a Peculiar Cam.

Editor American Machinist:

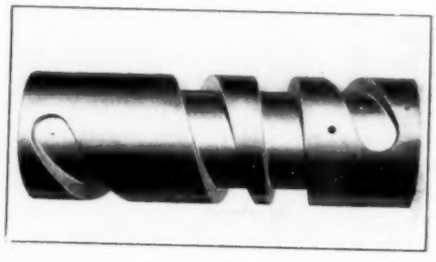
Recently I had occasion to true up the table of a slotter. It was a new slotter, too, and to be used on work requiring precision. The table was too large in diameter for any lathe in the shop and its inaccuracy caused too much vexation to be longer endured.

After a little thought I rigged up the pneumatic drilling machine to drive the worm shaft of the circular feed, fastened a planer finishing tool to the ram, clamping the ram tight, and by feeding the table across the tool, while the air drill rotated the table, a new finishing cut was made on its surface.

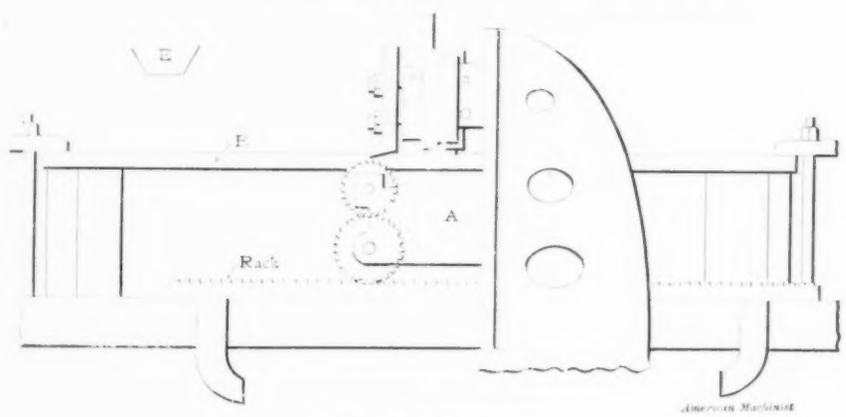
Then it was discovered that the face and sides of the ram end were not perfectly in line with the slides of the table. These surfaces were corrected by securing the same planer tool to a block on the table and feeding the tool across while the ram worked up and down.

That mended those evils. At about the same time, just to keep my wits alert, there came a peculiar job; and although my line of work has included the crookedest articles, this one was a puzzle. It was a cam groove to be cut on the outside of a steel cylinder. The cylinder was 5 inches diameter by 16 inches long. The groove, as at *E*, exaggerated, measuring 1.5 inches at top, 1.375 inches at bottom and .6 inch deep, started and stopped in solid metal—that is, it did not run out of the cylinder at either end. The lead of the groove started at a sharp angle, then changed to a line nearly parallel to the ends, and then swept off at another sharp angle, making three turns in 15 inches. It was impossible to cut this groove in a lathe and also out of the question to try it on the universal milling machine, because the lead varied at every point of advance. To follow the layout from day to day would have been too trying to a man's nerves and moods, and then it would have to be "slicked up" with file and scraper, an uncertain and expensive method. It was necessary to cut this cam correctly, because much depended upon its accuracy; so, after some scheming, the following method was adopted, and it produced a perfect result in twenty-five hours actual time on the cam itself.

A supplementary cross-rail *A* was designed and mounted under the true cross-rail of the planer. The cylinder was mounted on the supplementary rail under the planer tool. A cast-iron guide-plate *B*, with a slot developed from the groove to be cut, was placed between the heads and fastened at each end to a block on the



THE CAM AS CUT.



CUTTING A PECULIAR CAM.

planer platen. The cross feed screw was removed. A steel sleeve on a vertical stud was fastened on the bottom of the tool head. This sleeve worked in the slot of the guide-plate. A gear of 5 inches pitch diameter was keyed to the end of the cylinder, an idler gear of the same pitch diameter ran on a stud beneath, and this idler engaged also in a rack that we robbed the 24-inch lathe of and bolted to the planer platen.

As the rack on the planer passed forward and backward it rotated the cylinder in contact with the planer tool and the platen, carrying the guide-plate *B*, gave the tool the required lead by pushing the sleeve along the slot in the guide-plate.

Of course the planer tool only did the roughing out, for the width of a varying pitch groove will vary; so, to make the width alike throughout the length, we mounted the pneumatic drill in place of the planer tool, inserted a milling cutter of the shape of the required groove and cut both sides and bottom simultaneously.

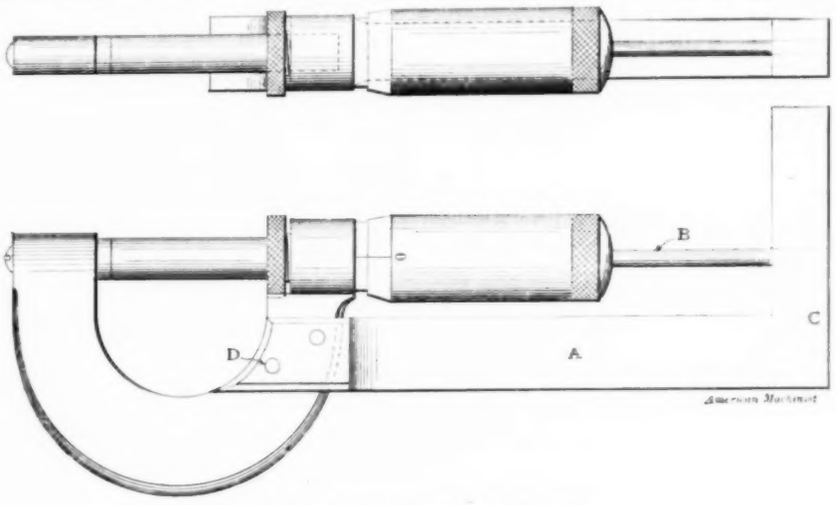
J. F. VAN HORNE.

Depth Gage Attachment for Micrometer.

Editor American Machinist:

I have noticed in several issues of the "American Machinist" of late a combination micrometer and depth gage, which idea is all right; but one has to buy the micrometer to get the depth gage. All do not care to do this, as they have one micrometer already. In such cases the attachment here shown will answer the purpose very well, and when not in use it can be removed and put away in the tool box. *A* is a piece of steel gotten out in the shape shown and finished to correspond with the micrometer. It is attached to any ordinary micrometer in the manner represented, using two taper pins *D*, which will keep it tight and in proper position. Pin *B* is screwed into the head of the micrometer to a shoulder, and can be taken out and put in with little trouble. When hardened and put together as here shown and set on the zero mark, the face *C* is lapped to a nice surface, the end *B* finished flush with it. Altogether this makes a very good gage, as I have had occasion to borrow it several times from the man who made it.

M. W. LEECH.



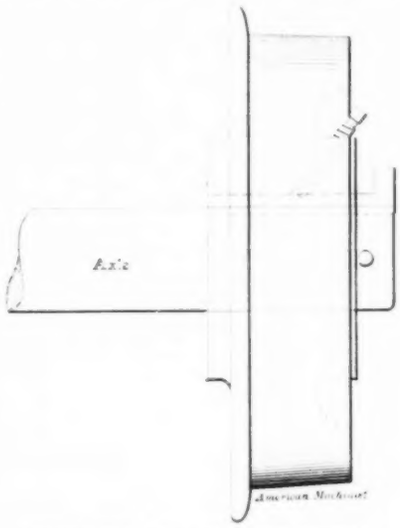
DEPTH GAGE ATTACHMENT FOR MICROMETER.

Fastening Keys in Track Wheels.

Editor American Machinist:

Having experienced difficulty in preventing keys from falling out of track wheels, notwithstanding that the keys were a driving fit, I devised the following means of overcoming the difficulty. After placing the wheel and key in their proper positions I drilled a 5/8-inch hole in the hub of the wheel at an angle of 20 degrees directly over the key, allowing the drill to enter the key just enough to spot it. I then removed the key and filed a notch on the key, where it was spotted to correspond with the point of the set-screw (which was the ordinary cupped point). The notch was filed so that the set-screw would have a good bearing, at the same time keeping the burr which was raised from preventing the removal of the key when desired. It is obvious the wheel cannot come off, owing to the cotter pin, and the key cannot come out, for any tendency to do so only holds the screw tighter as it causes an end pressure on the sides of the threads. No more trouble since using this idea.

R. A. L.



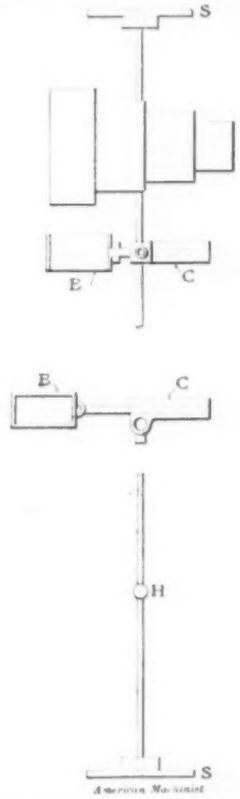
FASTENING KEYS IN TRACK WHEELS.

Cone Belt Shifting Device—Shades for Shop Windows.

Editor American Machinist:

The belt-shifting device for lathes shown in the sketch is giving good satisfaction in the few shops where it is known. It consists of a rod *A*, pivoted top and bottom, and of the casting *C*, fastened by a set-screw and carrying *B*, which is feathered in so that it can slide in *B* but cannot turn; the whole being operated by the handle H set at right angles to *B* and *C*, and at a convenient hight.

Most shop managers understand pretty well by this time the necessity of having plenty of light, but some of them seem to forget there may be too much of a good thing. It is just as desirable to have proper window shades in the shop as it is anywhere; yet there are factories where there are awnings for the office and no protection at all in the shop, unless the men tack paper over the windows, as I have seen done. This is the worst case. Then there are a great many shop windows equipped with window shades just a little too narrow, so that the shop is traversed by a number of bright streaks which interfere with the performance of the work. Here is an instance of "interference" which can be understood without any acquaintance with the undulatory



SHIFTER FOR CONE BELTS.

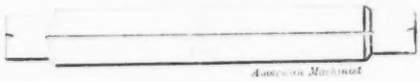
theory of light. The best arrangement I know is to have two shades—wide enough—to every window, one roller being at the top and one in the middle of the window. The advantage of this double arrangement is that when it is necessary to shade only half the window, as is often the case, the room is not made unnecessarily dark.

T. A. B.

An Adjustable Lap.

Editor American Machinist:

Laps are getting to be more and more used in machine shops, and rightly, too. With a good lap you can make as good a hole as can be done on a grinder, and



ADJUSTABLE LAP.

in less time. But you must have a good lap—not the poor excuses I've seen, and I guess we all have—usually of lead, which require renewal after each hole.

The best laps are made of cast iron, solid for small holes and they can be cored out and lightened for larger ones, with steel plugs put in the ends for centers. After turning them to size, making them about one and a half times the length of common arbors of the same diameter, cut a saw slot to within about 1 or 1½ inches from each end from both sides. Drill a hole across in the middle, tap and put in two blind screws, one from each side, so that when the points touch they will be below the surface. This lap will last for years, and is always the right size. Always use flour emery; it makes the quickest and best job.

B.

A Thread Tool and a Die Holder.

Editor American Machinist:

A shop-mate, Mr. Louis A. Essner, called my attention recently to the accompanying tools, which may be of service to the craft. Fig. 1 is a thread tool so arranged as to bring the cutting point at the position of the common lathe tools.

The cutter *a* has a pin *b* that enters the bushing *c*, giving the binding friction of this bushing as well as that of the head of the bolt *d*. This bolt *d* has a slot for the point of the screw *e*, so that it draws the cutter without turning it. The space at *g* admits of the cutter's moving to get the angle of the thread pitch right or left, and a few index lines give the angle. The tool is very firm and locks very securely.

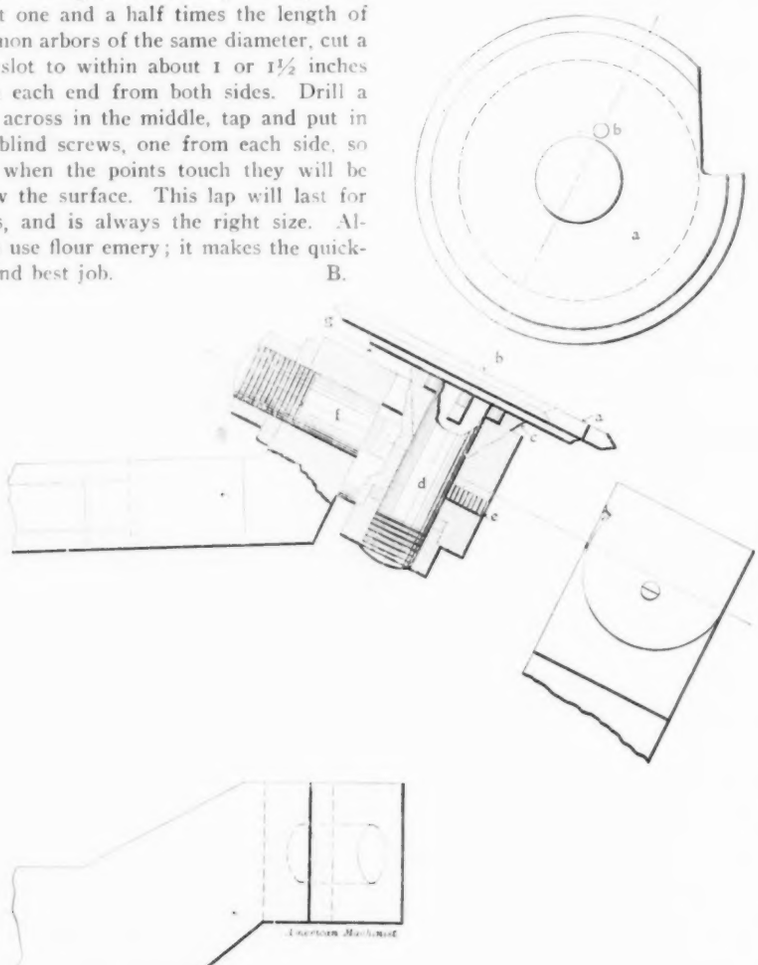


FIG. 1. A THREADING TOOL.

Fig. 2 is a screw lathe die-holder, to be made any size required, but especially adapted to overcome the loss of small screws that run out of true, a little or more. The two opposite free slides act against four springs and admit of the die's following the irregular movement of the work—a self-alining tool, as it is called. I am told that one of these dies will turn out thousands of small screws without loss by breakage.

A. H. CLEAVES.

[We do not consider it to be good practice to set a thread tool to the angle of the spiral of the thread unless the shape of the tool is modified to adapt it to such setting. Screw threads have an included angle of 60 degrees *measured on the axial plane*. This means that a thread tool that is made to the standard angle must have its top face set to coincide with the axial plane, in order to make the thread of 60 degrees angle; and this is not the case when the tool is inclined to suit the angle of the spiral. One way of overcoming this difficulty is to shape the tool with an accurately formed and set thread tool fed along at a rate which will give the disk tool the proper angle, or as nearly so as practicable—in other words, to make the tool a short section of a screw thread having the proper angle of its helix. It will then not need to be set at an angle to secure clearance and the resulting thread will be correct in form.—Ed.]

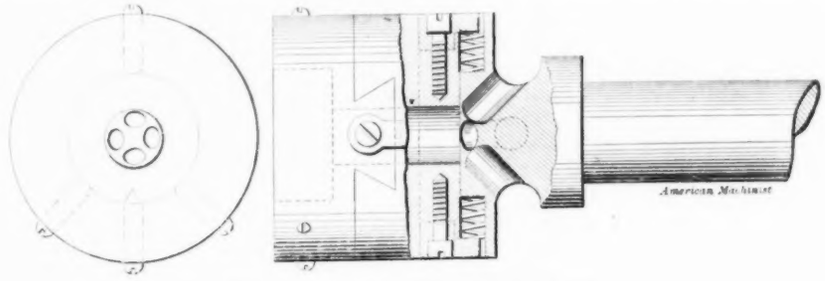


FIG. 2. A SELF-ADJUSTING DIE HOLDER.

Old Forms of Apparatus for Elevating Stock at Blast Furnaces.

Editor American Machinist:

The old pioneer iron furnaces used two methods of elevating the stock from the yard to the furnace top. Fig. 1 represents what was called a water balance, and Fig. 2 an air balance. The operation of the water balance was as follows: Platform *A* being at the furnace top and A_1 at the bottom on a level with the stockyard, after the man at the top had discharged the barrow and replaced it on the platform *A*, as shown, opening a valve in pipe from tank C to an opening in platform tank *B* allowed tank *B* to fill until the weight of barrow and platform with the water added would overbalance the weight of platform A_1 and its loaded barrow. The travel was controlled by a suitable brake. The operation of this device was very simple and it was used for several years, but, owing to the extremely cold climate, it gave

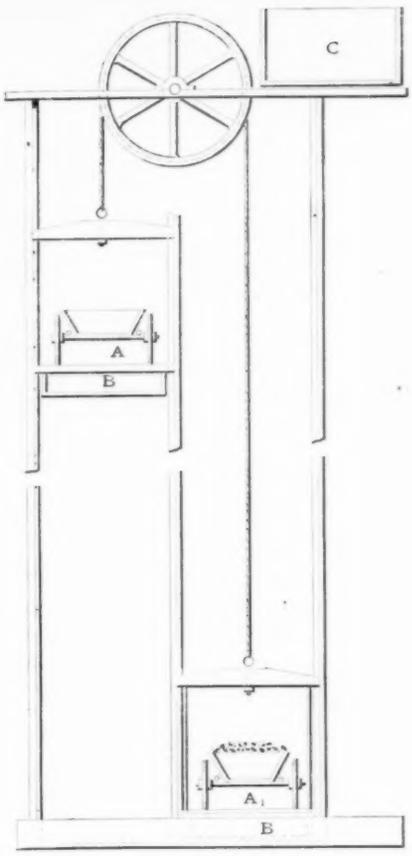


Fig. 1

THE WATER BALANCE.

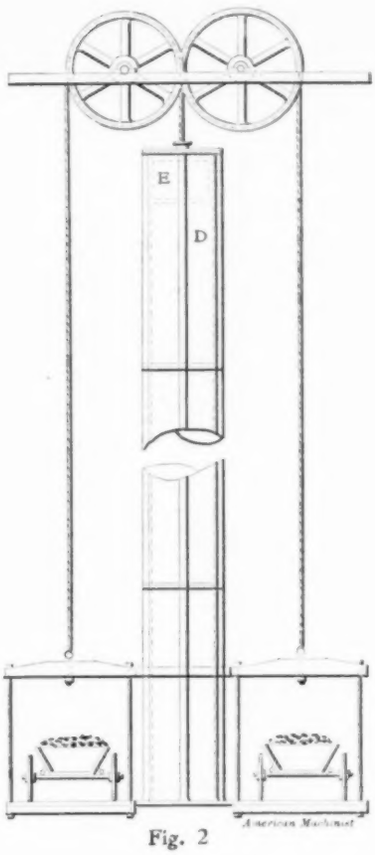


Fig. 2

THE AIR BALANCE.

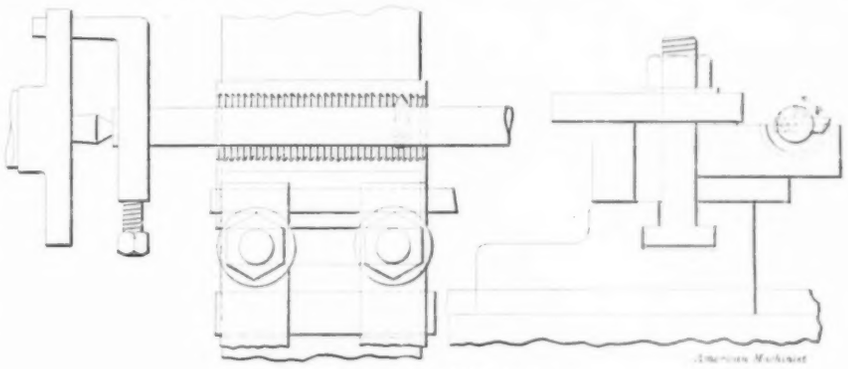
much trouble, as frost on the brake wheel caused several accidents, and the constant accumulation of ice made it necessary to turn steam in the tank *C*. With the thermometer at from zero to 40 degrees below, it was impossible to keep the machine constantly running.

The water balance was finally replaced by the air balance, shown in Fig. 2. This consisted of a cylinder *D*, about 36 inches in diameter and long enough to carry the platform to the furnace top. The piston *E* was hollow and filled with pig iron until its weight was slightly less than the combined weight of the two platforms and empty barrows. Starting with the platform in the position shown, air from the blowing engines was admitted on top of the piston. This air was at a pressure of about 2½ pounds per square inch, which was sufficient to force the piston downward and lift the platforms and their load. After the load was discharged and the barrows replaced on the platform, the air was exhausted from the cylinder, thus allowing the weight of the platform and empty barrows to return them to the bottom. This machine worked beautifully and never gave trouble of any kind, except in the coldest weather, when it was necessary to admit steam and heat up the cylinder from bottom to top in order to remove the frost that collected on the surface and prevented the free movement of the piston. I think this machine was built by the I. P. Morris Company, of Philadelphia, Pa. It was the first application of compressed air as a lifting agent that I ever saw. B. W. T.

Recutting a Half Nut.

Editor American Machinist:

The sketch shows how I saw a long half nut of relatively small diameter rechased. An ordinary boring bar was run between the centers in a lathe, and the half nut was clamped to the tool-block of a rise-and-fall carriage. The elevating screw and cross slide screw allowed of fine adjustment in setting up. The tool was held in bar just tight enough so that it could be fed out by the headless screw at the back of it. The job when completed was all that could be desired. The lathe was stopped after each cut, the carriage was run back and tool fed out for the next cut.



RECUTTING A HALF NUT.

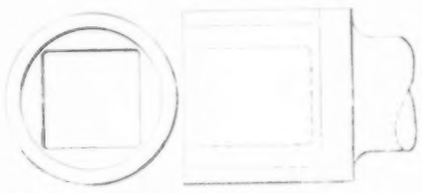
I think this was much more quickly and easily set up than clamping to an angle-plate on the face-plate, and the boring bar being supported at both ends allowed of a heavier cut than had been possible with an ordinary thread boring tool of such length and thickness. There was no more spring at one end of the nut than at the other.

P. A. G

Strengthening the Chuck Wrench.

Editor American Machinist:

Ever since I have been connected with machine shops we have always had trouble with the chuck-wrenches—that is, the wrenches for the lathe chucks. They usually break in the corners when hardened and wear out when left soft. I have a little kink which helped us out of our trouble: Turn down the end which has the square hole in to about 1-32 inch from the corners and force a tool-steel bushing on. The wrench will last indefinitely. We turn the end down, as per sketch, and case-harden. We use soft steel and fit the bushing on afterwards. We have sometimes not more than 3-64 inch on a side.



STRENGTHENING THE CHUCK WRENCH.

B

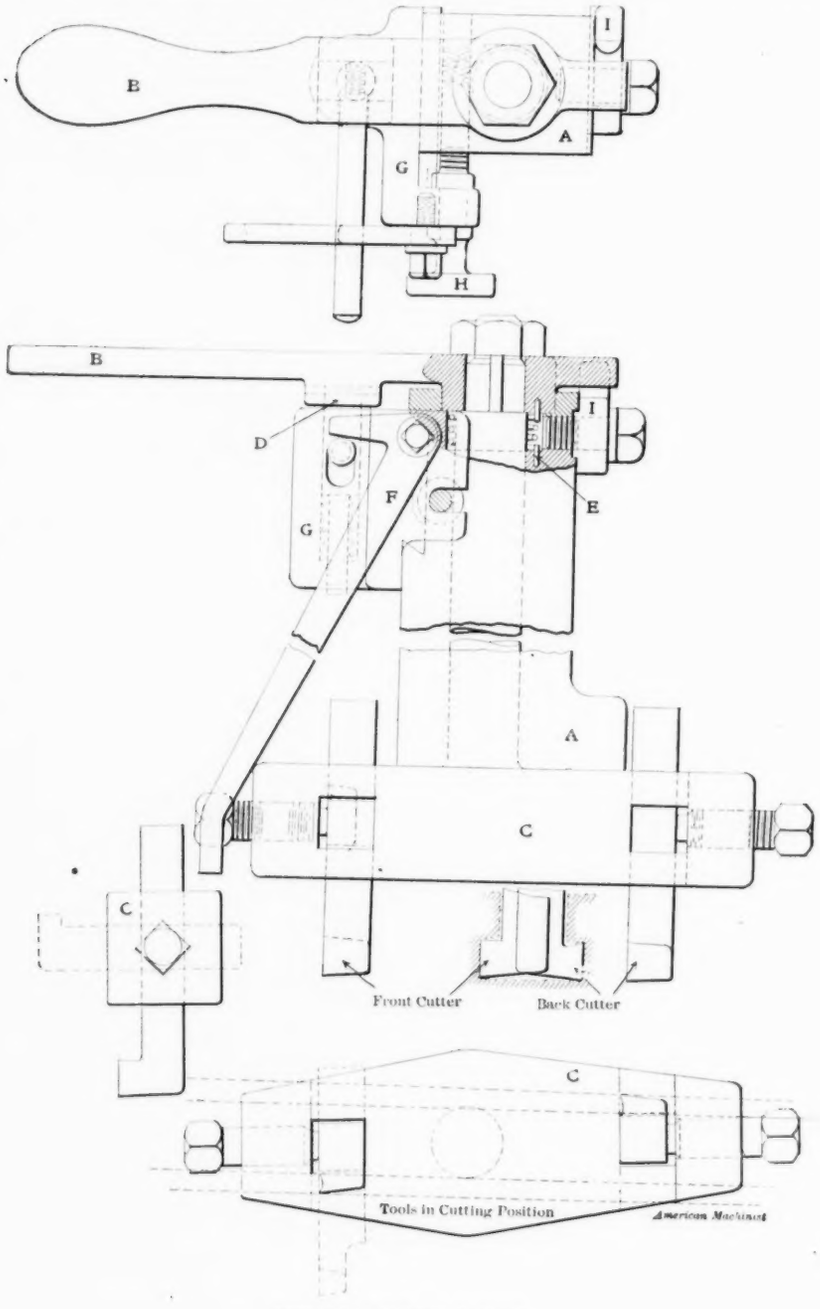
A T-Slot Planing Tool.

Editor American Machinist:

The accompanying sketch shows a tool constructed primarily for planing both sides of a T-slot at the same time. The tool may be built to fit any design or size of planer, and is arranged to release itself so that the cutters are clear of the work while the planer is running back.

It consists principally of a sleeve or holder *A* in which is held a shank, having

at its upper end a handle *B* and at its lower end an elongated head *C*, which has cutter slots in each end. The handle *B* being securely keyed to the shank and locked in position by the spring catch *D*, holds the cutters on opposite sides of the T-slot while taking a cut, and releases them by means of a rat-trap spring *E* when the spring catch *D* is withdrawn.



TOOL FOR PLANING T-SLOTS.

The spring catch may be withdrawn either by hand or by the automatic trip-lever *F*.

This lever *F*, pivoted on the same slide G which carries the spring catch *D*, projects downward and forward to a point sufficiently ahead of the tool to engage with any suitable stop secured to the forward end of the planer platen. This stop is placed so as to automatically trip the lever *F* just as the planer is about to reverse. The cutters are thus automatically released after they have made the cut and before the work starts back. All danger therefore of the tool catching is removed, while in the old way if the workman forgets to lift his tool he destroys either the tool or the work, and often both.

The feeding of this tool is accomplished by turning the knurled screw head *H*, which moves the slide *G* carrying the spring catch *D*. This tends to revolve the cutters around their common center, and moves them farther apart relative to the center line of the slot which is being planed. As the cutting stroke is about to start, the workman pushes the handle *B* until it is locked by the spring catch *D*. The tool is now ready to make a cut through the T-slot. In case this operation is forgotten, no damage results, as the tool simply runs through the T-slot without cutting.

At the upper end of the holder, on the back, an adjustable stop *I* is tongued in such a manner that it will stop the handle *B* at any predetermined point when the spring catch is withdrawn. This stop prevents the cutters from swinging too far after releasing.

The use of the tool is not confined to finishing both sides of a T-slot at the same time. It may be used for planing any groove, or a "V" of any shape or dimensions, either cored or cut from the solid. For instance, if a groove 1 inch wide is desired, by using a 5/8-inch front cutter and a 1-inch back cutter, twice the ordinary feed may be used, for, both cutters being in line and set to the same depth, there is only 3-16 inch of stock on each side of the groove to be removed by the back cutter. When used in this way the handle *B* is left locked in position, the automatic trip not being used.

Undercutting may also be done with this tool. To provide for such work, a tool slot at right angles to the regular one is provided at each end of the elongated head C. The cutters (in the front slot for one side of the work and in the back slot for the other side) project sideways, and the automatic trip lever is then used to release the cutter at the end of the stroke.

Various other kinds of work may be done with this tool, among which may be mentioned planing dovetails, either on top of or on the side of a piece of work, also grooves and T-slots on the side of a piece.

The tool may also be used in a lathe for turning both sides of a circular T-slot at the same time. When so used, the automatic trip lever is usually removed.

G. H. K.

A File Jig—Adjustable Hollow Mill—A Knurling Trick—Boring Tool Holder.

Editor American Machinist:

Fig. 1 will illustrate a file jig to be used for filing out dies. It is hardened and ground out perfectly square, and I have found it very useful for filing out plain dies as here shown. It is much easier and quicker than filing to the line. The die is all laid out and drilled in the usual way. After removing the center clamp the jig in place to the lines you have made and file to it, and you will find it much easier than breaking your back and straining your eyes where it is not necessary. You also will find that you are as near your lines as though you had filed to them, and you are certainly straighter than you could file otherwise. After having filed the die all out nicely you can give it the usual clearance, unless you have already machined it out for clearance to make less filing, as many do. In using a jig of this kind there is no danger of spoiling your corners if you set your jig right, and, where fillets are required where a round

file is near enough to the shape, it is equally good.

Fig. 2 shows a type of hollow mill which in my judgment is quite a good thing, as it stands up to its work well and does a nice job. It is only good for certain kinds of work and is used in the drill press in connection with a jig. The upper portion of the mill is fitted into a holder which in turn is fitted into the spindle of the press, the body being hardened and ground to fit the bushing in the jig. *A* will represent the cutters, which are made of drill rod and are a wringing fit in the holes. They can be adjusted, when ground from time to time, by the adjusting screws *B*, and when set are held from turning by the set-screws *C*, the cutters being filed or milled for that purpose. The cutters are cut off about the right length and put in place, and are adjusted so that the distance between the cutting points *D* will be the diameter to be cut and are then faced off at right angles to the axles, as shown. After this is done, they are taken out, milled half away and backed off as usual. It is well when making the tool to make several cutters extra, so when one set is worn out or broken others will be ready to take their places. They are put in at at an angle of 10 degrees. The cutter *E* is for facing off the end of the work in almost any shape desired, this one being flat, and is adjusted by the screw *F* and held from turning by the set-screw *G*. The hole in the body of the mill is somewhat larger, to allow for clearance.

Fig. 3 shows the operation of a machine-shop kink that very few, I think, have ever seen, and still it is quite old. The reason I say that very few have ever seen it is that they have tools now in most shops for the purpose. Still a fellow is liable to strike one of those old-fashioned places that is not up to date in anything, as was my luck to do a while ago. Such schemes come in very handy in such places, where they expect a man to do all kinds of work with nothing to do with. The job which I had was the making of some plug gages, and when the work had advanced to the point where I needed a knurl (a diamond or checked knurl) to knurl the handle there were only straight cut ones. I selected one of those which I thought would be about right and put it in the holder and finished my job by tipping the knurl, say 30 degrees, or as much as the space in the tool-post would allow, which happened to be all right in this case, and which gave me the first cut. Then tipping the knurl the same amount in the opposite direction gave me a nice check knurl. There is one special advantage about knurling in this way. The knurl cuts its way into the stock instead of pressing or forcing, which is the case with the regular check knurl. It is also to be noticed in using a knurl in this way that the diameter is not changed, while in using the check knurl it is increased several thousandths. It might be to advantage to use a knurl in this way quite often. If more angle is required than can be got by tipping the holder in the tool-post, hold it in a V-block, using the tool-post slot for bolts to clamp it down with.

Fig. 4 shows a style of boring tool for the engine lathe which is quite convenient in many ways. Besides being used for a tool-holder simply, I find it very handy as a V-block for drilling holes in small work, as many times the screw can be used to hold the piece down while the work is being done. The holder is grooved on both its edges, and the yoke is free to turn on the pin *B* to the opposite side, where smaller tools can be used. *C* represents an indicator designed to be used in the holder. It differs from others only in having the body round, taking up less room in the kit as well as lessening the weight. The center point *D* can be removed, and a ball, as shown by the dotted line, may be put in its place to indicate small holes. *E* is a piece of hardwood or steel about a foot long, tapered on one end to fit the

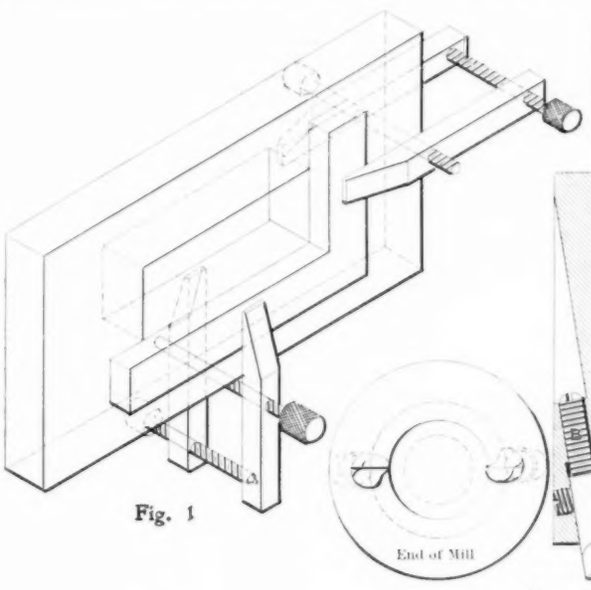


Fig. 1

Fig. 2

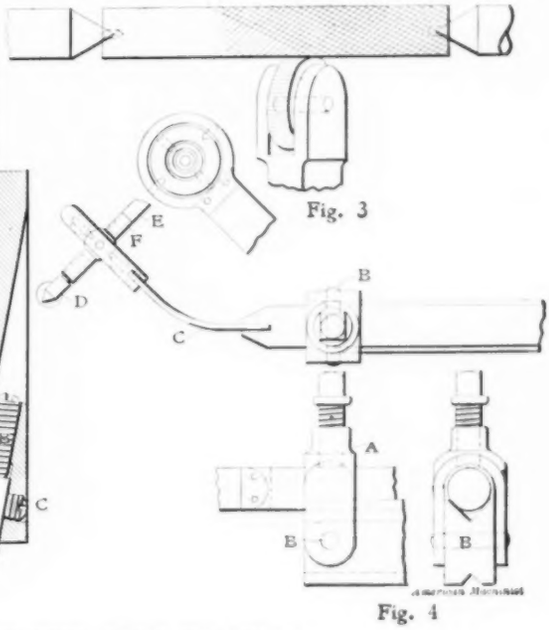
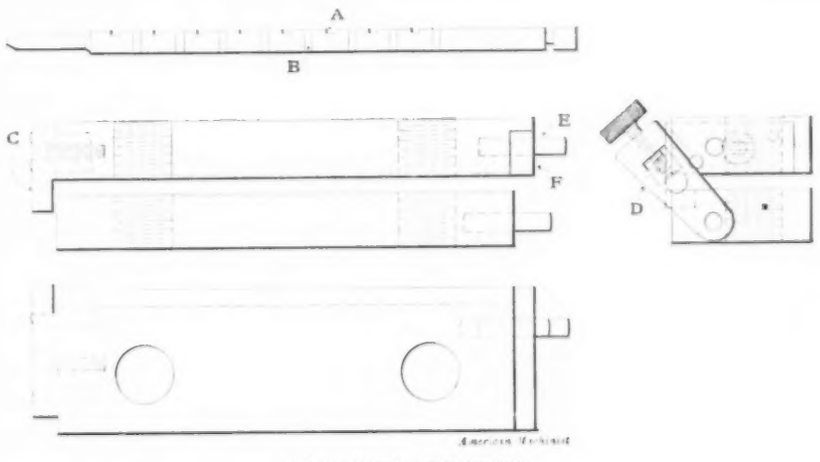


Fig. 3

Fig. 4

A FILING JIG—ADJUSTABLE HOLLOW MILL—A KNURLING TRICK—BORING TOOL HOLDER.



A MILLING MACHINE JOB.

piece *F*, the rest being tapered from this diameter gradually to a point.

M. W. LEECH.

A Milling Machine Job.

Editor American Machinist:

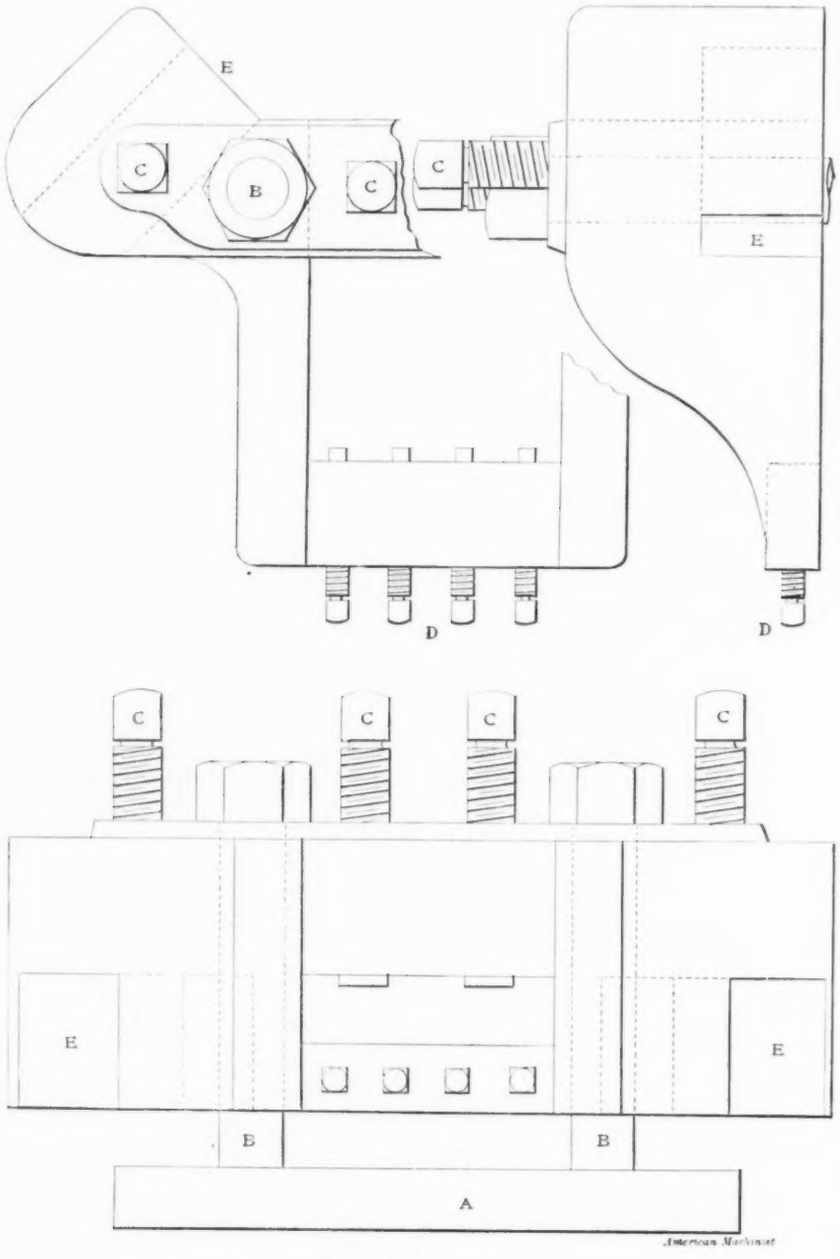
The enclosed sketch shows a piece to be milled and vise-jaws for holding the same. The pieces were made of Bessemer rod the exact size, one end being turned in the screw machine and the other end simply necked in, as shown. The milling of the slots was the most particular part of the job, as they had to be milled at right angles with each other, as shown at *A* and *B*, with a set of gang milling cutters. In the first operation—that of making the series of cuts at *B*—the piece was held in the vise-jaws against the stop *c*. After this cut was made, the locating dog *D* was adjusted, then the piece was released and located for the second milling cut by slipping the end of dog *D* over pin *E*. The side of vise-jaw *F* acted as a gage point for the second milling. C. O. D.

A Tool Post for Heavy Turning.

Editor American Machinist:

The accompanying sketch shows a tool-post designed for use on a heavy chucking lathe and especially useful for turning and facing the rims of pulleys, flywheels, rope sheaves and similar work.

The piece *A* fits in the T-slot of the slide rest and by means of this the bolts *B* hold the tool-post to the slide rest, the set-screws *c* hold the tools in their respective positions and the small set-screws *D* are used to line up a gang of nicking, grooving or forming tools made of 7/8 or 1 inch Mushet steel, so that they can be ground up individually, easily and inexpensively.



TOOL HOLDER FOR HEAVY TURNING.

Side tools of various forms and shapes can be held in the slots *E*. With this post and a good machine I have cut six 7/8-inch circular grooves at once and a cut 3 inches wide with a feed of 1-32 inch is common work. This refers to cast-iron wheels from 2 to 6 feet in diameter.

WM. H. BROOKS.

Bolt Slots in Machine Tools.

Editor American Machinist:

I have never noticed that your readers have made any kick about the slots in drill-press tables, slotters and shapers. It has been my experience that makers are too stingy with the dimensions of this detail of machine tools. Either the slot is too narrow for the diameter of the general run of bolts, or not deep enough for the head. Grinding must be resorted to, and this takes time. If bolts are used which will fit these slots as to diameter it has been my experience that they are too weak to hold the work, and in many instances where a machine has sufficiently large slots for heavy bolts the walls of the slots are too thin and pull out, causing uneven tables, etc. More time is lost in setting up work than to perform the same, owing to these little details in the construction of tools. "TRAMP."

Fillet Gages.

Editor American Machinist:

The "fillet gage" shown by "Cynic," page 32, I have seen used in more than one shop. I enclose a sketch of a good one,

FILLET GAGES.

but a bit of trouble to make. It consists of eight folding blades mounted like thread gages. Four are fillet gages, two for the ends of studs or bolts, which will do for almost any size, and two chamfer gages for valves, valve seats, etc. This little tool will well repay for the making.

T. H. FOULSTON.

Stroud, England.

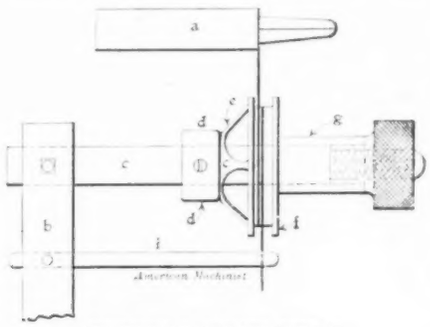
Winding a Square Spring.

Editor American Machinist:

I had some square springs to make of brass wire 1-32 inch in diameter and 1¾ inches long. We first made a square arbor about 12 inches long and wound as near

the length of the arbor as possible, using for tension a block of wood with two small holes, the wire passing under and over the block through the holes. This rig answered for a short time, but as the holes wore the tension grew less and by the time the end of the arbor was reached the spring was not wound tight enough.

We tried several different devices, but at last the method here sketched was employed and it proved a success. The first operation was that of making an arbor *a*, the large end being held in a chuck in a small bench lathe. The small end of the arbor was made square, of the desired size and straight about the length of two coils of the spring when it was gradually tapered smaller outward to the end, enough so that the pressure of the wire on the shoulder by winding would continually crowd the preceding coil of the spring forward and force it from the arbor. A continuous spring could be thus wound as long as the coil of wire would permit. For the tension a piece of lathe tool steel *b* was cut off and a 3/8-inch hole was drilled through it. The shaft *c* was then made of 3/8-inch steel, one end being turned to 5-16 inch and threaded. The



WINDING A SQUARE SPRING.

steel collar *d* was held by a set-screw. The tension spring *e*, of sheet brass as hard as could be obtained, had four arms of the shape shown and fastened to the collar by two small pins, so that it would not turn. The small steel pulley *f* was made a running fit on the shaft. The steel collar *g* was drilled to slide over the large part of the shaft. The knurled nut *h* was adjusted to give the required tension. The steel *b*, being secured in the tool post, the shaft *c* was placed in position and fastened by the set-screw, a small hole 1/8 inch in diameter was drilled through holder *b* parallel with the 3/8-inch hole and at a distance large enough to allow a piece of 1/8-inch wire to pass through and have a space of 1/4 inch between the wire and the flanges on the pulley. A piece of 1/8-inch Stub's wire had one end flattened and a hole drilled 1-32 inch larger than the spring wire. This hole was bell-shaped on both sides, all the sharp corners were rounded and every precaution was used to prevent the scratching of the wire. This part was hardened and left very hard to insure against wear, and then polished until a fine finish was obtained. This wire or guide was then placed in the small hole in *b* and fastened with the set-screw. It was made to give some tension to the wire by rolling it until opposite sides of the hole touched the wire. The wire running freely from a reel passes through the hole in *i* and then around the pulley *f* two or three times, which depends altogether on the temper of the wire. The wire is then run to the arbor *a*, a number of turns around the arbor being taken to hold wire while starting.

When I began to wind the spring, after it became a few feet long, I experienced trouble with its kinking. This was overcome by bringing a garden hose into use, fastening the end a few inches from the end of the arbor and laying it out straight on the floor. I found the spring would easily turn itself if kept straight, and the hose served this purpose. The lathe can be started and a coil wire can be wound into a spring in a short time. If the spring runs a little large and the shape is a trifle changed more tension makes it all right again.

VER. I. NIER.

Two Types of Needle Box Tools.

Editor American Machinist:

The box tools here sketched were for turning the points of needles used on gasoline lamps. These needles are made from mild tool steel, similar to bicycle cup and cone stock, and the operation is very hard on tools and dies, two dies, a rougher and a finisher being required to chase the thread, which accounts for the apparently small output.

The tool, Fig. 2, was made first, and with it we could turn out from 125 to 150 in a working day of ten hours. I then designed Fig. 1, and with it we averaged 300 in th same length of time. It consists of a forging of mild tool steel, the shank turned to fit the turret and the front end squared up in the lathe. It is then placed on the centers of the milling machine, and the sides and bottom are milled square with each other. Then it is placed in the vise and the top of the body is milled away exactly to the center, as shown. This gives the working point from which to locate the cutter and rests. The center opening is drilled, milled and filed out, leaving the portion *a* to strengthen the body of the tool. The clamp *b* is then milled and fastened in place by the binding screw, the location of the hole for the shank of the cutting tool is determined, the hole is laid out and the tool is then swung upon an angle-plate on an engine lathe face-plate, trued up with an indicator and bored. The clamp is then taken off and 1-32 inch is milled off the front of the bottom, leaving it about 5-32 inch wide at the rear, to allow the clamp to bind the shank of the tool, which is similar to a screw-machine circular tool. The tool is now put in the milling-machine vise and the two slots are milled for the rests 1-16 inch below the center or top of the tool and 3/8 inch wide. The rests are now milled or planed to fit the slots closely, the holes are drilled and elongated for adjustment and the working parts of the rests are machined out, which must be half the diameter of the work to be turned plus the 1-16 inch which the rest is sunk in the body of the tool below the center.

An over-all tool, or sizing tool, was first run over the needle, the turret was rotated, the tool brought forward and the front rest pressed lightly against the body of the needle and clamped in position by the binding screw. The cutting tool was then brought forward and the first point was carefully turned without a rest. The back rest was then adjusted in the same manner as the one in front, and we were then ready to run out 1,000 needles with-

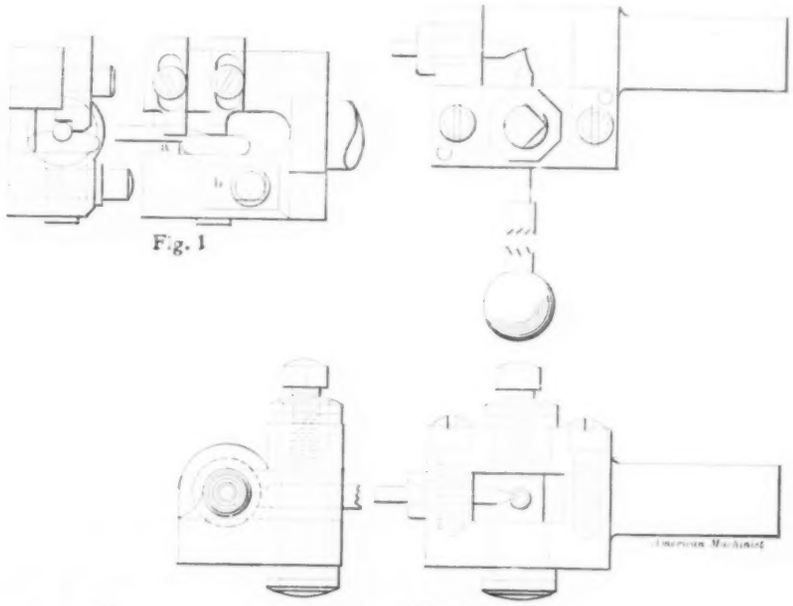


Fig. 1

Fig. 2

TWO TYPES OF NEEDLE BOX TOOLS.

out grinding the tool, as it was left as hard as fire and salt water would make it, only being warmed up to take the strain out.

The tool, Fig. 2, consists of a forging of the same material as No. 1, with the shank turned, the ends, sides and bottom squared up and the center milled away, as shown. The cross bar is then machined and fastened in place by the two screws and dowels. A piece of iron or brass, held in the engine lathe chuck and bored a wringing fit for the shank, serves as a holder while the front is being bored to receive the bushing, which is hardened, lapped and ground to drive in snugly. The hole for the swivel tool-post is located and bored, and the bushings, which have been hardened, are lapped and ground and pressed into place.

The post is made of tool steel, allowing 1-100 inch to grind. A projection is left on the bottom which is nicked in to be easily broken off. By this projection the post is held in a spring collet to be accurately ground to fit the holes in the bushings, and when finished the end is broken off. This post is threaded on the ends and the tool is raised and lowered by means of the nuts. The needle is first sized with an over-all tool, as with Fig. 1, the turret is run forward against stop and held there by the right hand of the operator, who grasps the handle of the swivel tool-post with his left, forcing it to the right and the tool to the left, turning the point and concaving the needle, as shown.

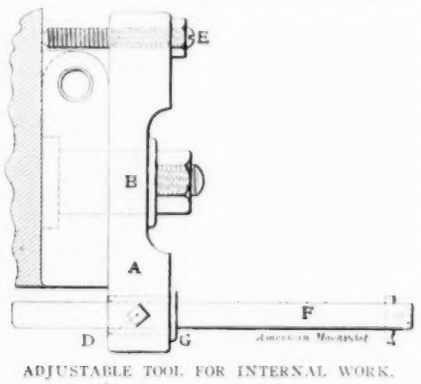
W. E. CALLAGHAN.

Adjustable Tool for Internal Work on the Shaper.

Editor American Machinist:

The accompanying sketch of an internal gear and keyseating fixture should explain itself. The part *A* is made of machine steel to the required size as best adapted to the shaper and the class of work. *B*, the stud, is fitted snug in the apron. *C* is a split bushing which may be made any size smaller than the hole in *A*, as found convenient. This hole is made to take the boring bar from the Armstrong lathe boring tool-holder, as we keep the Mushet steel in stock for use with the same. *D* is the set-screw which tightens on the split bushing, clamping the bar in place. *E* is the screw, with jam nut, which may be adjusted to suit the operator. I find it very convenient to adjust so that the bar *F* will lift enough to clear the cut on the return stroke, which will allow the tool to hold its edge much better. One advantage that I find in this fixture is in the easy adjustment for different lengths of stroke. It was designed with the view of getting as close to the work as possible on jobs of different lengths, therefore eliminating any unnecessary springing of the tool. Very good results may be obtained with this fixture on internal gear work. By making a master tool with the gear cutter and planing up a small tool, it will give good satisfaction on internal gears with a fine pitch. The ready turning of the tool in different directions makes it adaptable to almost any internal work on the shaper.

S. B. M.

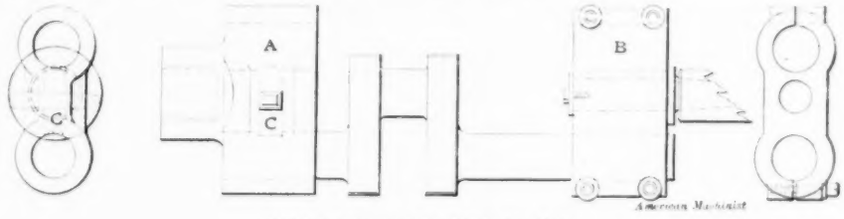


ADJUSTABLE TOOL FOR INTERNAL WORK.

Handy Rig for Turning Cranks.

Editor American Machinist:

Once having charge of a number of men in a shop using a great many crank shafts, and having the crank man get "on his dignity," set me to thinking that I must introduce something that would allow the boys to turn the cranks if necessary. The chuck *A* is screwed on a lathe center and is bored to receive the roughly turned end of a crank. As here shown, it is designed for two different throws. A casting *B* also is mounted to rotate on a long bearing with a stem fitted to a tail spindle and bored exactly the same as the headstock casting or chuck *A*. When the crank is set in the position desired to turn the pin, grip block *C* is forced into the shaft by means of the wedge shown. The tailstock is now brought up so that the crank shaft will be engaged at this end, as shown. When the clamp screws are set down and all is ready to push the job, the man or boy may take the largest kind of cut, the tool will stand and the work will not move. Care should be taken to get all the holes bored as nearly perfect as possible, so that you may be sure of perfect alinement. Good results may be obtained by removing a very slight amount of metal on the grip-block side of the hole, thereby making the hole slightly oblong, so that the shaft may be entered and removed more readily. Should the crank be a double or triple, or have any number of pins to be turned, the loosening of the keys, the turning of the next pin to come true and the driving of the keys again home is all there is to setting a crank shaft in this fixture.



HANDY RIG FOR TURNING CRANKS.

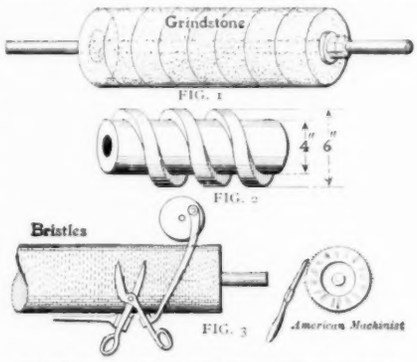
I would be pleased to have someone of your readers, who is in the business and is still holding to fastening a lathe dog or a clamp on the ends of crank shaft, carrying the outfit to the laying-out table and with surface gage (after many annoying details) locating centers, try this arrangement. He will not go back to the old way after.

BECK.

Cutting a Steep Pitch Screw in Grindstone—Turning Calico—Truing a Roller of Bristles.

Editor American Machinist:

A stone roller 4 feet long by 6 inches diameter was required with a square thread cut the whole length, for grinding the "fluff" off fustian piece goods. The sketch, Fig. 1, shows how we fixed it up. We obtained eight grindstones 6½ inches diameter by 6½ inches wide and with holes to just fit the shaft. A collar was welded on one end, and the stones were tightened by means of lock-nuts at the other end, keys being fitted into the shaft to engage with the two outside stones and with the washer plates behind the nuts. We relied upon the large surface of contact to prevent the middle stones from slipping. Lock-nuts were used, owing to the high speed at which the roller was to be driven. Fig. 2 shows the particulars we had to work to.



THREADING GRINDSTONES AND TURNING BRISTLE ENDS.

We experienced no difficulty whatever in turning the roller to a perfect cylinder, our difficulties commencing when we attempted to cut the thread. We made a good start, however, with a fine-pointed tool set with as little rake as the job would stand, in order to keep the edge up as long as possible. We were congratulating ourselves upon the fine way the tool was eating the stone, when, crash! and the saddle had stopped running and the tool was cutting a groove right around the roll. We

stopped the lathe, however, in time to prevent damage. Upon examination we found the reversing gears on the headstock had stripped off their teeth, evidently too weak for the job. We were in a hurry, so we took one of the wheels and had four phosphor bronze ones cast the same day and fitted on. Off we started again, but this time we kept our eye on the wheels. The teeth were immediately bent up, jammed themselves, and stopped the lathe. Seeing that we had our strongest lathe on this job we were now in a fix. Something had to be done, as our customer was at a standstill. How would it be, I thought, to put a pulley on the screw and thus take some of the strain off the wheels? I could see, however, that this would not do, as the lathe was much out of date and we would have trouble through the back-lash, which was considerable. Then a great light flashed upon my brain. The screw was in this case the quickest moving shaft. Why not drive this and let the wheels drive the lathe spindle? We soon had a pulley bolted on to the change wheel and a belt to the main shaft. In two twos the job was done, the method being quite a success.

The other job was somewhat similar to this, in that the dimension and construction were the same; but instead of stones being mounted on the shaft disks of calico were the abrasive. This roll was for a "mop" for polishing purposes. When the calico disks were clamped into place and the roller mounted into the machine and rotated at the correct speed, it was found to be so much out of balance as to knock the machine about. It was decided to turn the disks up. The centrifugal force was so great that the calico stood out like a board. A bar rest was mounted along the front of the roller and an attempt was made to turn it with ordinary wood-turners' tools. The edge would not "stand up" an instant—presumably on account of the stiffening in the material and also from its elastic nature. Where steel tools fail an old bucket answers. An old bucket was found and the iron was cut off, the top edge being jagged or serrated like a saw. Upon this being presented to the work it acted beautifully, the stuff flying off in clouds, covering the whole shop with fine cotton dust until it had very much the appearance of a cotton mill.

When the circular brushes used on cotton goods finishing mills require their whiskers to be trimmed up, fix one blade of a pair of scissors to the tool-post of the slide-rest and connect the other blade to a crank on a bracket bolted to the slide-rest top plate. Put on a quick feed to the saddle and a slow speed to the brush, the scissors being set approximately to the angle of the thread, which would be cut according to the particular gearing used. It is necessary to go over the roll several times, as some hairs are skipped each time.

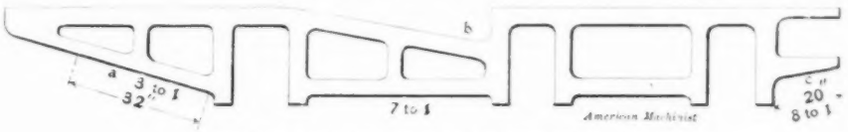
FRANCIS W. SHAW.

Birmingham, England.

Oblique Slotting by Combination Feed.

Editor American Machinist:

In a large locomotive works is a double-head slotter running night and day shaping locomotive side frames, many being of the type shown in the sketch having several surfaces at oblique angles, the obliquity differing, as at *a*, *b* and *c*, where the ratios of each are noted. The double-head



OBLIQUE SURFACES TO SLOT ON SIDE FRAMES.

slotter above spoken of is a kind of special machine. The frames are bolted flat upon a stationary table, and all the movements required for the cutting operation, both the vertical stroke for the actual cut and the horizontal movements in either direction for feed, are accomplished by the tool carrier, the work remaining stationary.

The oblique surfaces in a large number of these frames were machined by moving one end of the frame off the table and placing it on horses, thus bringing these surfaces into line with the normal tool travel. It must be evident that this was a costly operation, taking into consideration the time and trouble and also that only one of the heads could be used at a time. Another plan by which many of the frames were finished was to take them one at a time to a small slotter and there machine these oblique surfaces.

Lately a set of frames were removed from the large double-head slotter and it was found that the surfaces *a*, *b* and *c* were all nicely finished, a far better job than had ever been done before. This was a big surprise all around. These frames had never been near the small slotter. It looked mysterious, for a foreman had been in charge night and day and nothing unusual had been noticed. How, then, was the job accomplished?

The man who thought out and placed in practical operation this beautiful solution of the problem was found and readily explained his method. It was simply to use the lateral and longitudinal feeds simultaneously. The combinations thus obtained caused the point of the tool to travel in the direction desired, taking both roughing and finishing cuts and producing a very fine job. In the sketch the surface *a* shows a ratio of 3 to 1: six teeth of the longitudinal to two of the lateral were used, and similarly with the others.

Now, noting that both heads were in constant operation shows that this is a brilliant idea. It is simplicity itself, but the results accomplished are well worth recording in your valuable publication.

FRANK RATTEK.

Grinding Hacksaws.

Editor American Machinist:

S. V. S., page 204, has had his say about hacksaw frames. I would like to say something about the saws themselves. In 1886 or 1887, one night after hardware stores were closed, a piece of iron came to me to be cut off. Now, I always carry a frame and some saws, whatever shop I happen to be in, as there are shops where it doesn't pay to keep them for all hands to use, and so they are not kept. The ones I had were at this time too dull to cut, there was no place to get any, and a saw was the only thing that would do this particular job. As a last resort I tried sharpening the saw on the corner of the dry grindstone. It was one of those hard saws—the "Griffin." The saw when ground finished the job. Since then I have ground all my hacksaws. The emery wheel is best and quickest. I have ground the Griffin saws from three to nineteen times for cutting of steel, iron, brass, etc. The blue-backs are not the ones to try this on, as in drawing the temper from the back it also to some extent softens the cutting edge. In one shop where I worked over six years, I used the saws brought to me by the sweeper, and the men in the shop would come to borrow my saws, because they said they were the only ones that would cut, outside of brand-new ones, and better even than some of them. The edges of the saws looked outrageously rough and irregular, but they would cut. Why they would cut so well I cannot say, but I am able to prove it to any doubting one, or he may prove it for himself by trying it.

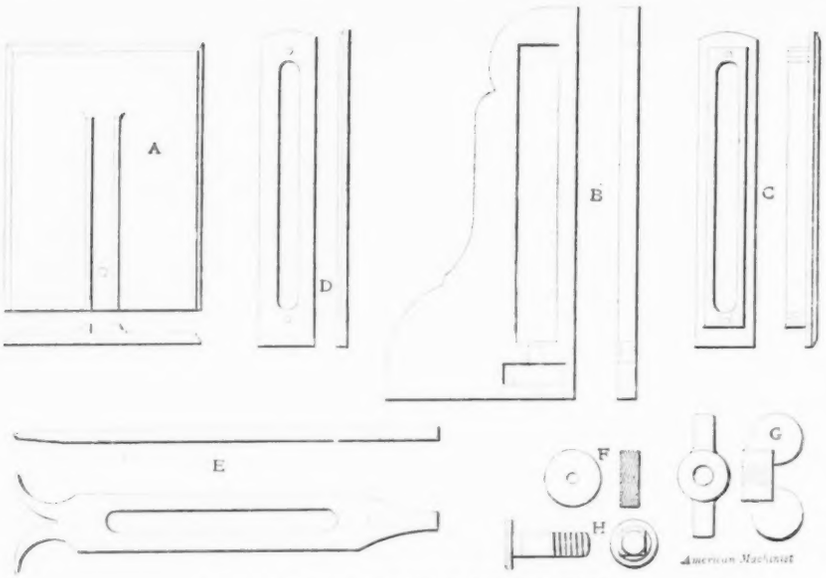
A SUFFERER.

A Scratch Block and Surface Gage.

Editor American Machinist:

I send you with this a sheet of details of a handy toolmaker's scratch book and surface gage which has a much greater range than the usual type of scratch block. *A* is a base of machine steel made as shown. *B* is the upright or frame which carries the adjusting slide and nut. *C* is the adjusting slide, and *D* the adjusting slide gib. *E* is the movable arm in the hole in the end of which the tool steel scratch point is inserted. *F* is the adjusting nut, *G* an ordinary wing nut which binds the movable arm and *H* the bolt for the same. In this particular gage the upright is fastened to the base with soft solder, which seems to answer very well, although a couple of screws may be used if desired.

The body of *C* is made a good fit in the slot in *B* and of a thickness which makes a nice sliding fit when *D* is clamped to it in tightening up the arm and ⅛ inch shorter, which is the amount of vertical



DETAILS OF SURFACE GAGE OR SCRATCH BLOCK.

adjustment in the gage. The adjusting nut *F* should fit the opening in *B* nicely to make as little lost motion as possible. The adjusting slide *C* and gib *D* are fastened together with pins riveted in the holes shown at each end, the lower pin also serving to hold the adjusting screw, which is a straight screw or stud extending down into the hole shown by the dotted lines in *B*.

In using this gage, after roughly setting and clamping the movable arm, it is grasped in the right hand, the fingers and thumb resting on the base, which brings them in position to operate the adjusting nut. Thus the gage can be held down and adjusted with one hand, which leaves the other free to hold the work or scale as the case may be. This gage combines a good range with lightness, which are both good features, and if nicely made, will make a good addition to any tool box.

THEODORE.

Planing Helical Grooves—A Workman's Trick—Drilling Rings from the Inside.

Editor American Machinist:

I send you sketches of two rigs which were used in a shop where I worked. Fig. 1 was for cutting a 17-pitch thread, as we called it, on shaft *A*. There was one thread in 17 inches, quadruple thread, or say four helical grooves. Two brackets or standards *B B* were bored to fit the ends of the shaft. They were clamped to the planer platen, with gear *C* keyed on shaft *A*. The rack *D* was held in place by chips *E*, also bolted to the platen. These allowed the rack to slide freely across the platen without any shake. The bar *F* was fastened to the web between the planer shears and housing, with block *H* a nice sliding fit. The angle of bar *F* could be changed for different pitches; in fact it was actually used for other threads than the original thread it was made for. The nut to go on the shaft was made afterwards of babbitt metal cast on the screw, with the outside of the nut of brass. This job had formerly been done on a lathe rigged up with special gears, but it was never satisfactory.

I heard of a neat trick in connection with this job. One man was given the job of cutting the first few screws and also the nuts. After he had finished all the screws he struck the boss for a raise. The boss would not give it to him, so the man quit. The boss put another man on the job of threading the nuts. The man finished the first nut to size all right, but could not get it on the screw. He cut more off the top of the thread, the bottom and the sides, but it did no good. In the meantime the man who cut the screws was back for his tools and his money. The boss spoke to him of the trouble they were having. The man said he would fit those nuts without any trouble if he got the raise. The boss put him to work again and he turned out the nuts in fine time. Naturally the boss was puzzled, but after a great deal of questioning and jollying he found out where the trouble was. In cutting the screw, when changing the teeth for the last thread, he turned the gear one tooth more than a quarter turn. He did it with the intention of getting a raise, and he got it. The boss thought that a man as slick as that was worth more money.

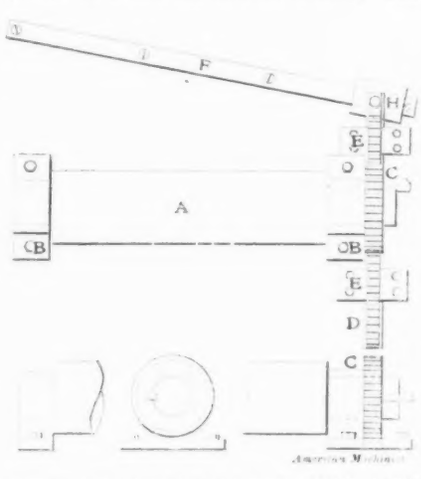


FIG. 1. ARRANGEMENT FOR PLANING HELICAL GEARING.

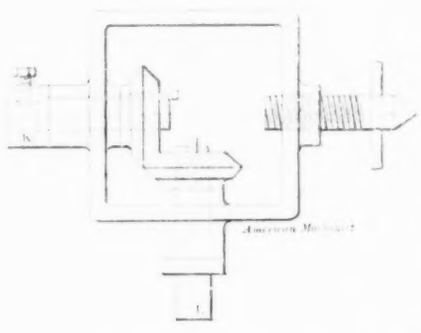


FIG. 2. FOR DRILLING RINGS FROM THE INSIDE.

The rig, Fig. 2, was for drilling a lot of rings 9 inches in diameter from the inside, as they were not to go through the metal. The drill, 3/8 inch, was held in socket *K* by the set-screw shown. The end of shaft *L* was fitted to a small air drill socket. The rest of the rig, I think, explains itself.

LATHE HAND.

A Jig for Drilling a Large Number of Castings.

Editor American Machinist:

I send a sketch of a small casting, Fig. 1, in which a 3-16 inch hole *A* was to be drilled part way through. There were about 25,000 of these castings. The hole *A* was required to be accurate in relation to *C*, *B* and *D*. I first made a small jig to hold a single casting, but after drilling a number I saw that it required a longer time to take a casting out, clean the jig and put in a casting than to drill the holes. To give the operator, a boy, time to clean the jig, put the casting in properly and keep the drill press working, I devised a holder as shown in the sketch. Instead of holding one casting I provide places for two, and in this way the drill press was constantly working and the job was done better and in nearly one half the time we figured on.

Referring to Fig. 2, *J* is an angle plate fastened to the drill press table, and against the face of it is pivoted by the screw *S* the plate *I* with two pockets *E* for locating the castings to be drilled. The castings are held in position by the swinging arms *G* and the locking levers *H*. All the holes are drilled through the one hardened drill guide or bushing *K*. The plate *I* is held in position for drilling either hole by the locking pin *T* in one of the four holes *P* in the face of the angle plate *J*. The pin *T* is operated by the lever *K* which also serves for swinging the plate *I* when the pin is drawn back far enough to clear the hole in *J*. With the jig in position for drilling the hole at the extreme left, as shown, the pin *T*

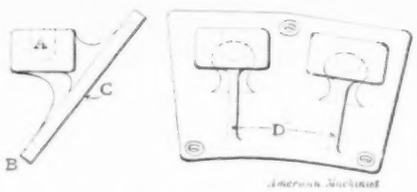


FIG. 1. THE CASTING TO BE DRILLED.

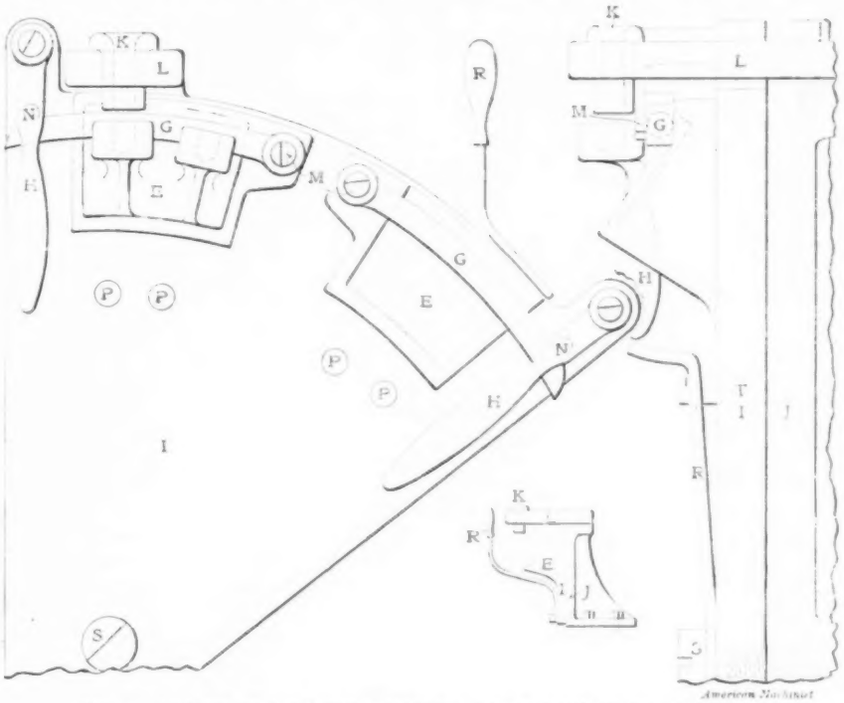


FIG. 2. SKETCH OF A JIG FOR DRILLING A LARGE NUMBER OF CASTINGS.

would be in the hole *P* at the extreme right and *vice versa*. The gage for depth was of course provided on the drill spindle. WILLIAM MURPHY.

Enlarging a Hole in a Pulley Hub.

Editor American Machinist:

In putting up a factory in the backwoods we found that we had on our hands a pulley 72 inches diameter by 14 inches face which was bored 3 9/16 inches, while the shaft on which it was to run was 3⅝ inches diameter. We had no tools beyond a 24-inch engine lathe and a small smith shop. It was impossible to get the pulley in line with the lathe spindle on account of its large diameter, and as we were in a hurry to get it on the shaft we adopted the following means for enlarging the bore. We turned up a good solid piece of hard maple with two diameters, as shown in the sketch. At one end, and long enough to steady it, the stick was turned to correspond with the bore of the pulley 3 9/16 inches, and at the other end 3⅝ inches. The tool was inserted as shown, and held in place by a wedge and a feed screw was rigged up on the small end of the stick. Two long ⅞-inch bolts inserted in the holes at the large end of the improvised boring bar served as turning levers. With two farm laborers doing business at this end and a third working the feed nut, the bore was increased by the desired amount in one cut, and it was completed in a little more than an hour.

MECHANICUS.

The Use of the Internal Shaper Tools.

Editor American Machinist:

I was pleased to note the interest aroused by my sketch on page 25 of inside shaping tools, no less than three readers having sent in similar devices, the designs of W. H. B. and of Mr. Roberts being similar. Mr. Roberts claims that his device is much cheaper than mine, and I see no reason to dispute the claim. While it would be equally good for splining, for the work which my fixture was originally designed for his could not be used at all. The splining bar was an after-thought. The new apron was designed to hold special shapes of forming tools, to plane dies in a factory where one man is kept constantly on the shaper making duplicate dies. He has a tray full of tools of the various shapes, and he uses them to such good effect that the dies come to the filing bench needing only two or three thousandths of an inch of stock to be filed out. The shaper tools are only long enough to reach through the die with a very slight clearance. ISAAC MORGAN.

A Correction—Shrinkage of Wrought Iron.

Editor American Machinist:

On page 209 you make my reference read to *Horne's* "Metallurgy of Steel." It should be *Howe's* "Metallurgy of Steel," the work written by Henry Marion Howe. I often have difficulty in reading my own handwriting, but had always been under the impression that editors and printers could read any kind of writing, even if the writer could not. It is quite a relief to find they are not so far above common mortals after all.

I would like to add a word about the behavior of iron when cooled suddenly. It does not act just the same as steel, for although the specific gravity of a piece of wrought iron will be decreased in about the same ratio as a piece of tool steel by heating to a red heat and cooling quickly, wrought iron will contract in the direction of the grain. This property used to be taken advantage of in bridge works when they made eye-bars of wrought iron, to correct mistakes made in boring the eyes of the bar too far apart. The mistakes so corrected never exceeded ⅛ inch, and by heating a couple of feet of the bar and cooling in water that much could be easily taken up. Most wrought iron can be made to contract ⅛ inch to the foot by two or three successive quenchings. This property of iron is also of great advantage when overhauling old machinery, and such things as connecting rod end straps which need to be taken up a small amount, 1-16 to 1-32 inch usually. If the blacksmith starts to close them by a few blows, the chances are he will mark them or knock the strap out of shape, but it can all be done by simply heating the strap to a red heat and cooling in water. If the first quenching doesn't do it, try a second.

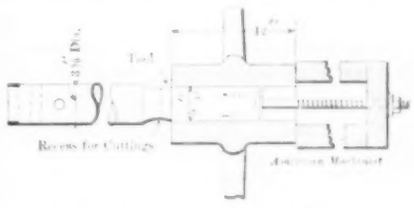
PERSEVERANCE.

[No one can be sure of reading a proper name correctly unless each letter is so made as to be unmistakable. It is a rule of this office not to write but to print them (with a pen), and it would save much bother if our correspondents would follow that plan.—Ed.]

Molding Pipes of Different Lengths—Ring Cores.

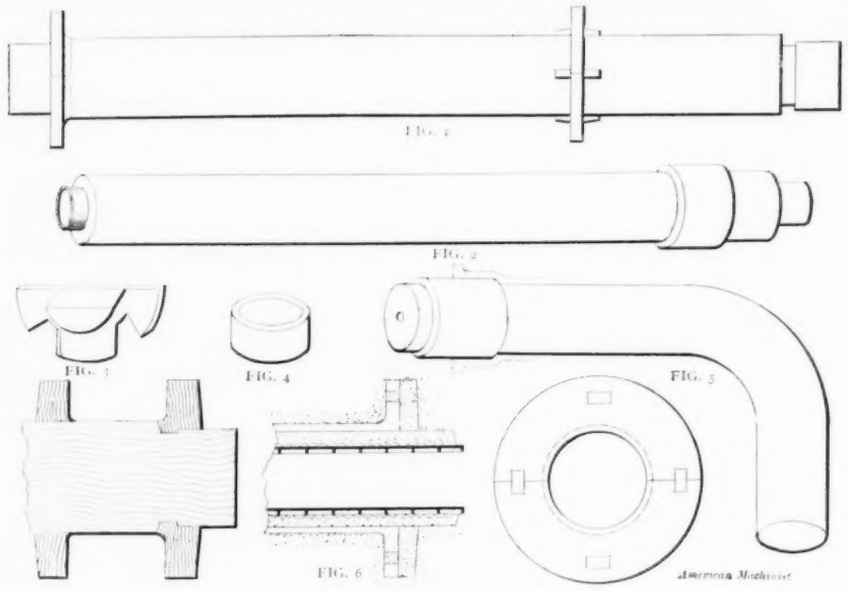
Editor American Machinist:

Fig. 1 shows a pipe pattern with one flange fixed on to the body of the pattern to the length required. This method of preparing a pipe pattern is quite common in most shops doing a general line of castings, when only one or two castings are required. Fig. 3 is the templet which usually accompanies the pattern for setting the cores in the flange and also to form a bearing or print for the end of the mold in which is fixed the body flange. This method takes considerable time and patience in order to obtain a flange without any lap or twist, or a core which is perfectly set as to thickness of metal.



FOR RE-BORING A PULLEY HUB.

When molding small and medium-sized pipes of various lengths, ring cores, Fig. 4, give good results. These cores have a



MOLDING PIPES OF DIFFERENT LENGTHS.

hole of sufficient size to enable them to be slipped or threaded on to the pipe core, as in Fig. 2, the outside diameter of the ring core being the same as the pipe body. No making of the mold is required by this method, so that the body flange is finished quite as quickly as the flange at the other end of the mold, and there is better prospect of invariably obtaining a straight flange with the core in the center.

No special core boxes are required to make the ring cores, there being usually standard sizes at hand. A wooden plug being set central in the box the cores are made in a few minutes by the coremaker. These ring cores are also found to answer very well for sockets when making either turns or straight pipe. Fig. 5 shows a ring core slipped on to a bend core, forming a socket bend.

Another method of stopping pipe to length required is shown on Fig. 6. Cores forming the face of the flange, and also the bolt cores, are set into suitable prints as shown. This is a quick and ready method; it is, however, practicable only when runs of pipe are wanted having flanges of the same diameter, as different sized core boxes are required for flanges of different centers, diameter or thickness. The ring cores, however, are applicable generally, and are not affected by any of the above-mentioned particulars.

GEO. BUCHANAN.

Wrexham, North Wales.

Tool Holder for Internal Work on Shaper or Planer.

Editor American Machinist:

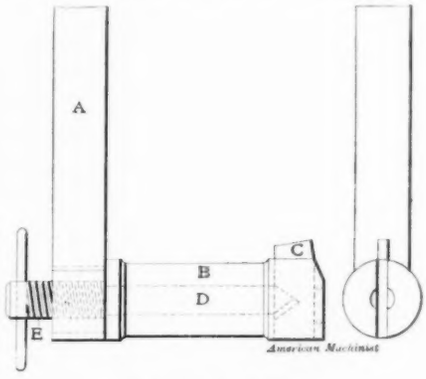
Recent articles in your columns bring to mind a tool I designed and had made, when in charge of a shop building a special line of machine tools. On one style of machine that we built the power was transmitted from the shaft carrying the main pulley to the cutter spindle by means of a hollow shaft which telescoped over the main shaft and slid back and forth on it as the machine was adjusted from one position to another. Power was transmitted from one shaft to the other by means of a key fastened in a slot in the hollow shaft and sliding in a slot in the other. It was necessary that the key should fit nicely in both shafts, sliding freely in one, yet not rattling. As we had a milling machine with a pair of centers which lined nicely, it was an easy matter to cut the slot in the internal shaft; but when it came to cutting the slot inside the hollow shaft, that was another matter, as the slot was 4½ inches long, ¼ inch wide and 3-16 inch deep, and must be perfectly straight and true. The hole in the shaft was 1¼ inches diameter.

I happened to remember the method we used in feeding the cutter of a rifling rod when I worked on gun work. When the rifling operation begins, the cutter is flush with the surface of the bar, but is fed out into the work by means of a wedge which is forced under the cutter. In the case of a rifling rod this feeding is done automatically; but in the cutter I had made the feeding was done by hand, as it was necessary for the operator to stand by the work all the time, and a tool fed automatically would have cost a great deal more.

I enclose a sketch of the tool. *A* is a shank, made of machinery steel; *B* is the cutter bar, *C* the cutter, *D* a pointed bar used to force the cutter into the work, and *E* is a screw which pushes the bar *D*. The shank after being worked to shape was strapped to the face-plate of a lathe and a hole was bored to receive the cutter bar. The object of boring by this method was to insure a hole perfectly square in each direction.

The cutter car *B* was made of machinery steel, there was a 7-16 inch hole drilled and reamed from the back end of the bar to within 1 inch of the cutter end; a ⅜-inch hole was drilled the balance of the distance; the back end of the bar was tapped with a ½-inch, 24-thread tap for a distance of 1 inch to receive the feed screw. The other end of the bar was slotted after turning. The bar was turned on an arbor having two portions, 7-16 inch diameter, which fitted the hole in the bar. One end of the arbor was turned slightly under ⅜ inch, so as not to touch in the ⅜-inch hole. The bar was turned slightly large on each end to allow for grinding; a shoulder was left to back against the holder; the intermediate space was turned 1-16 inch smaller than the hole in the shaft to be planed. The slot for the cutter was milled ¼ inch wide, 1 inch deep and exactly central. A piece, ⅜ inch wide and ¼ inch deep, was fitted in the outer end of the slot and drilled for pin holes. The bar was case-hardened in oil to prevent springing. After hardening, the ends were ground, one end to fit the holder, the other about one-thousandth of an inch smaller than the hole in the shaft, and the piece was riveted in end of the slot.

The cutter *C* was made of tool steel, a crowding fit in the bar. A 90-degree "V" was cut in the back to receive the point of the pushing rod, which, bearing on one edge of the slot, forces the cutter out as it (the rod) is fed in. It should be so fitted that when the cutter is flush with the bar the point of the pushing rod will bear at least 1-16 inch on the edge of the "V," which should be deep enough to allow the cutter to be fed out the proper distance before the point strikes the bottom. The cutting edge should be beveled back slightly, as shown, so that the cutter may not be drawn into the stock; it also makes a



A SPLINING TOOL.

smooth shearing cut. It should be backed off same as any tool for similar work. The pointed rod should be a good fit in the hole in the bar, hardened on the point and drawn to a deep straw color to resist wear.

The cutting end of the blade was on the top side of the bar, which prevented any jumping or chattering. This will be found a good idea to apply to almost any tool for inside planing work where there is a tendency to chatter. A hole was drilled through the clapper box holder into the box for a pin, which prevented the tool rising into the work on the return stroke.

This tool worked so satisfactorily that

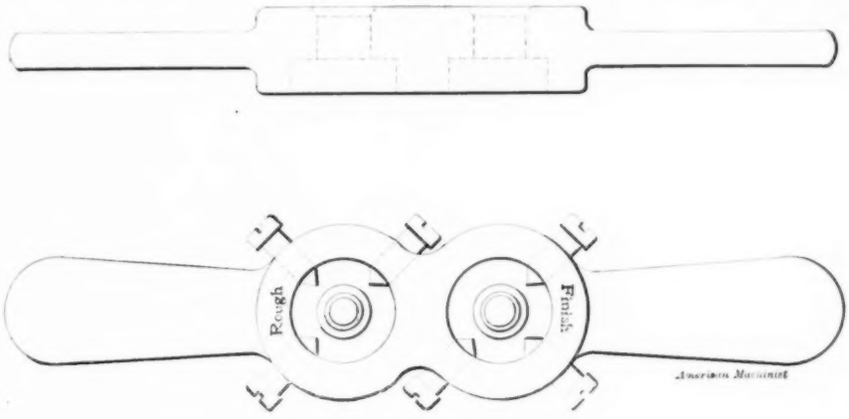
we made one of a smaller size for cutting a spline-way in a brass gear. The spline-way was 4¾ inches long by 3-16 inch wide by 5-32 inch deep, and the hole in the gear was ⅞ inch diameter; it worked as well as the first one. The same shank answered for both cutter bars. We afterwards used these tools whenever we did any splining that required a cutter the size of either of these, whether the bar fitted the hole in work or not. The results were better than with the regular tool feed by the tool-adjusting screw of the planer, as we could get a more uniform feed.

E. R. MARKHAM.

A Handy Die Stock.

Editor American Machinist:

The die stock shown is cheap and handy. It is made of cast iron and finished only where required. The face is marked rough and finish to distinguish



A HANDY DIE STOCK.

the two dies. The countersink at the back is true with the die, permitting the die to be used against the foot center as well as against the foot spindle or face-plate.

W. R. G.

Running Two Gas Engines Together.

Editor American Machinist:

I read Mr. Tygard's article, page 191, about two gas engines belted to one shaft, with some surprise, not at its being done, but that there should be any question of their working all right. I cannot recall just the same case in my own experience, but I have often set up a gas engine to be used in conjunction with some other motor and have never had any trouble. In one case in particular there were two large plants operated by water power, and it became necessary to reduce the supply by water for some time in order to make extensive repairs to the canal. So each plant installed a gas engine to help. In one of the shops—it was a large machine shop—they speeded the engine up a little, so that there was an explosion every cycle. The governors were of the hit-and-miss type. In the other shop the engine was not worked so hard, cutting out part of the time; but both of them worked perfectly satisfactorily.

It may be argued with some truth that it is a different proposition to harness a gas engine with a water wheel from coupling two gas engines together; but consider this last case. A gas engine alone and running light is supposed to govern at least well enough to prevent any noticeable variation to an ordinary observer. Now, suppose there is another such engine belted to the same shaft. Let each engine receive an impulse at the same time, and hence tend to accelerate. Each engine's flywheels will take care of its own engine to a great extent, the shafting and load also will usually oppose very sudden changes in speed. Now if one engine speeds up slightly above the other, it will tend to drive that one. This will act merely as so much load to the first engine, and certainly will not hurt its crankshaft or anything else. On the second engine it will have the same effect as reducing the flywheels somewhat, which, if anything, will reduce the strain on the crank shaft. The case when one drops behind the other can be considered the same way. In any case it seems to me that one engine would not seriously interfere with the other if both were properly speeded and were in good condition. B. A. T.

Reading Incredible Things—Catching Threads.

Editor American Machinist:

We read many things in the papers and occasionally we strike something new, or or at least that we have not heard of. The following extract from an account of of a railroad wreck in a daily paper is a new one to me:

"Gazing into the cab, my attention was so intent on the fireman and engineer, looking like animated Rembrandt etchings in the glow of the furnace, that I almost forgot to leave the track, and narrowly escaped being run over by the laboring engine as it swept past me, the resisting drivers grinding sand and the 'pop' valve exploding with the fierce rush of steam forced back into the boiler and out of the dome by the follower heads working in reverse. I had not gotten back more than a quarter of a mile, but to my great relief it was apparent that the train was fast slackening speed and would stop before plunging into the wreck."

Here is something new to me, as I never knew before that an engine when reversed not only takes no steam at all, but finds steam somewhere to pump into the boiler. Still, the writer of this article excites my envy, for he shows the ability to take a subject on which he is not well posted, write it up in flowery language, and make a very readable article, and which probably sounds all right to minds which are not mechanical. I suppose everyone is discontented and dissatisfied with his own particular lot in life; I am certainly with mine, and I aspire to the ability to write such articles as the one from which the above quotation is taken, for I think the writer must be a genius.

Some of us have recently read of a snowstorm accompanied by thunder and lightning, and, although I was brought up in the north country and have experienced all stages of winter up to drifts 15 feet high, including many kinds of storms, I have yet to see a snowstorm accompanied by thunder, although I suppose they occur in some sections of the country. I have also read of a boiler which would not make steam and keep the engine up to speed because the pressure gage was out of order. I can readily understand this, on the principle that the man will loaf or cut up if the boss happens to be absent or not attending to business.

Then there is the matter of jumping threads while cutting in the lathe. I have jumped threads in my time, and it has not mattered much whether the pitch corresponded with the lead screw or not. My method of doing this is to run the carriage back without stopping the lathe until the tool is about one quarter of an inch from the end of the screw, then to set the tool so that it just clears the screw, with the right hand on the lever which closes the feed nut, watching the cut already made as it comes around, until it exactly corresponds with the tool, then making a quick move to close the nut. If the combination is all right the nut will close properly, but if it is not right, of course it will not close, and you must slack it off the thread and wait for another turn of the screw when the operation is repeated, there always being of course a proper combination somewhere which it is necessary to wait for. If the thread to be cut is a multiple of the lead screw, this operation is comparatively simple, but in cutting fractional threads two or three attempts will sometimes be required before the nut is closed in its proper place.

This recalls an experience I had with a foreman one time when I was a cub. I had a very long feed screw for a milling machine to cut with a square thread, which I believe was three pitch, and if I remember rightly the pitch of the lead screw on the lathe was six. I drilled a hole in the screw where I wished to stop the

thread, set my tool so that it would run into the hole all right and started to run the carriage back by power to get the first cut on the screw for a guide. Just at this point the foreman arrived on the scene, and if he had been a minute later things would have been all right; but you know a foreman never sees a thing just in the right time: he either sees it too late to save it, or else before the man has had an opportunity to straighten out his job, and often causes embarrassment for himself and the man.

If he had given me a chance to explain, all would have been well, for he was an up-to-date man and right up to his job. He pushed me aside, opened the nut and ran the carriage back by hand and started in a cut. But here his luck was against him and of course he closed the nut in the wrong place, and as he was kind enough to stand by until the cut was finished he had the pleasure of seeing the tool stop on the side opposite to the hole I had drilled to receive it. He looked at it a minute and then told me to plug the hole and drill a new one on the opposite side, and I suppose he thought some things about foreman's luck in general.

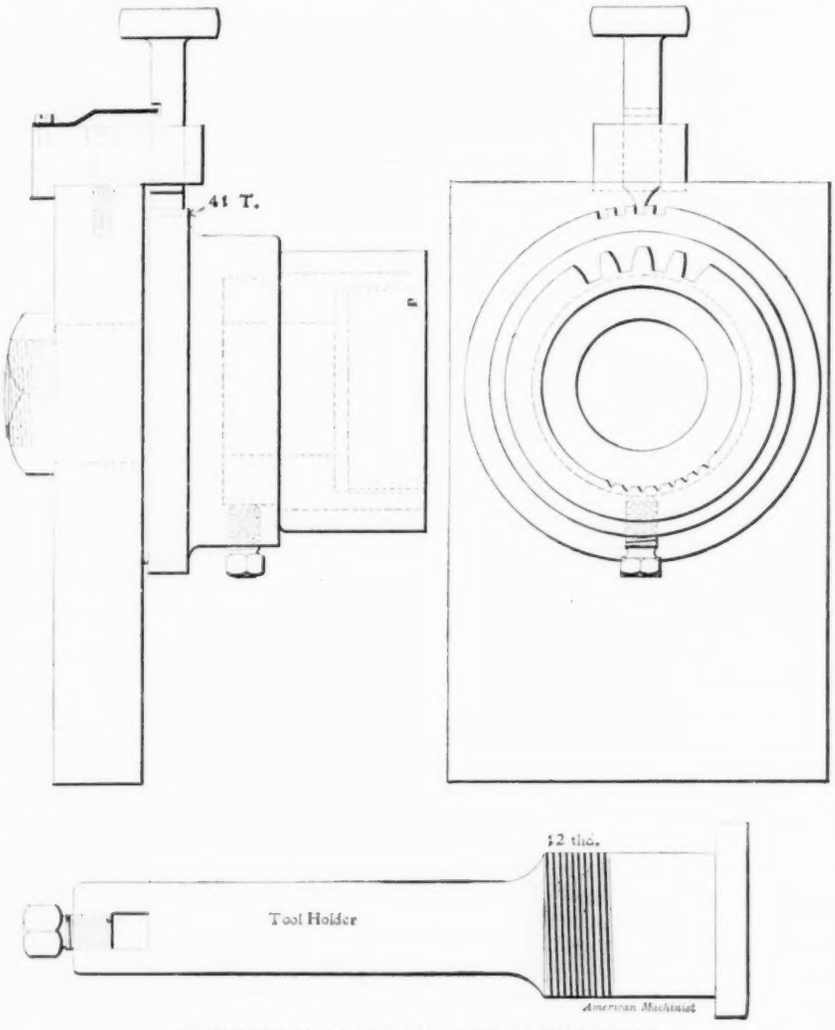
There was a lesson in that for me also, for I learned to run up a cut before drilling the hole, which also saves the running back by power the first time.

THEODORE.

A Shaper Rig for Cutting Internal Ratchet Teeth

Editor American Machinist:

The device shown in the sketch we are using with success to cut the internal V-shaped teeth in feed pinions used on several makes of planers. Those furnished with the machines are of cast iron, mere shells, and with us they are soon broken. Wishing to make new ones of common steel, and looking about for a quick and accurate way of cutting the teeth, I designed this simple rig to be held in the vise of our shaper, and using the identical tool bar illustrated in a recent issue. The sketch shows clearly the *modus operandi*. The pinion is held in the front of the holder by three 3/8-inch set-screws. The nut on the rear end secures the holder properly in the upright piece. The stop-pin drops into the toothed portion of the holder, it containing as many teeth as are desired to be cut in the pinions, and is held down by a stiff spring.



SHAPER RIG FOR CUTTING INTERNAL RATCHET TEETH.

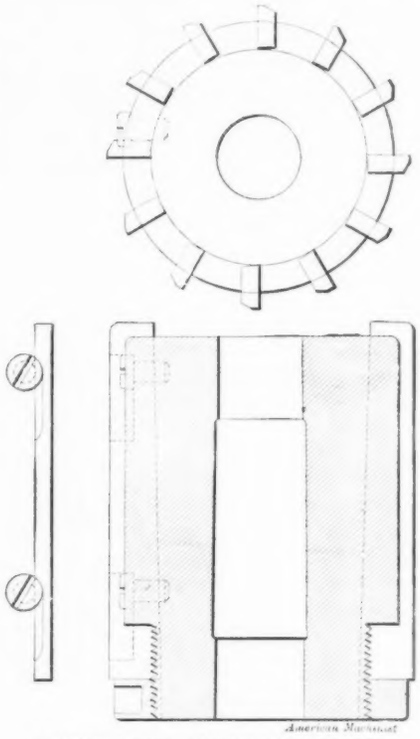
To insure a uniform depth of cut, a positive stop is clamped to the movable slide of the shaper head, and when a tooth is cut to the correct depth, this stop strikes the stationary part of the head. This device could also be used for regular internal gears to advantage. It may not be new or novel to many of your readers, but it certainly was to our men.

H. E. B.

A Reamer With Adjustable Blades.

Editor American Machinist:

While struggling with the reamer question several years ago, before adjustable blade reamers were as plentiful as now, a few reamers like the one in the sketch



REAMER WITH ADJUSTABLE BLADES.

were made, and they have given good service. The adjustment was obtained by moving the blades forward, the slots being deeper at the back than at the front. The high cost of producing these reamers singly was a barrier to their introduction in the shop where they were made. Whether or not they would prove economical in the end is a debatable question. The teeth are ground off on the end to keep them the proper distance from the body of the reamer, and this keeps the corner about the size desired. The taper being known, and the pitch of the screw, the readjustments may be made with minute micrometrical accuracy. There are of course two screws to hold each blade, although only shown for one. W. R. G.

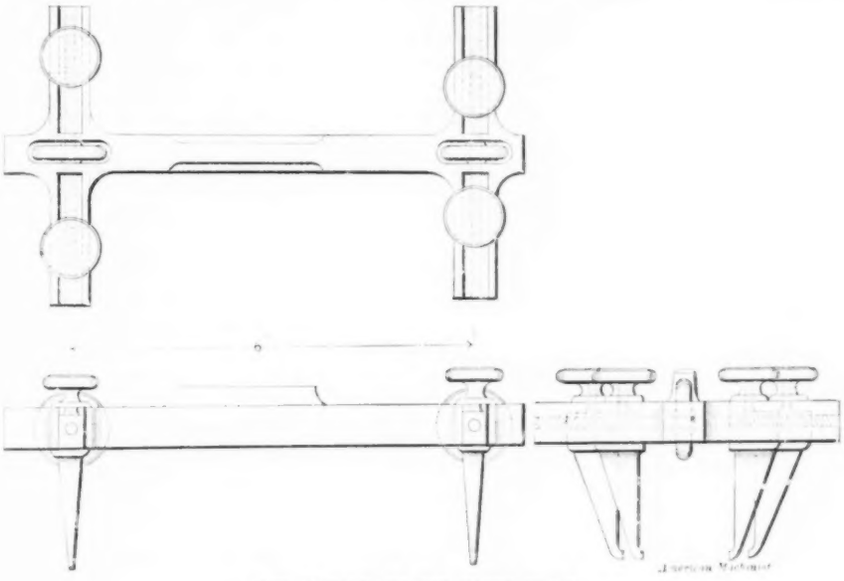
The Foreman's Caliper Swindle.

Editor American Machinist:

Jones is our foreman, and when he tells us a story we have to listen and to laugh appreciatively. Here's his latest:

"Way back a dozen years or so," he said, "I had a job tool making in a Down

East shop where they made a specialty of, say, building monkey-wrenches, because that's what they didn't do, and I don't care to be at all personal or precise. I had then a pretty good kit of tools and I felt rather proud of them, so one day when I got my micrometer caught in the crank planer and bent all up I felt mighty glum. The blamed old trap had an unhappy faculty of starting up when you didn't expect it to, and the 'mike' was down on the work in such a way I couldn't get it out of danger. Well, it was a complete wreck; doubled up sideways, body bent, nut and thread also, and the little tack-like hardened point in the end of the screw spindle loose and broken as well. I don't think much of this plan of construction, anyway. Well, I put it in a vise and straightened it up with a wrench until, looking at it sideways, you wouldn't notice anything wrong with it, but you couldn't turn it a particle.



DUPLEX CALIPERS FOR TAPER WORK.

"I did some hard thinking that afternoon, for I hadn't had the tool very long, and its loss meant a good deal to me at that time. That night I put the thing in my pocket and I went uptown where I bought another, with a case just like that containing the wreck. Now, that afternoon I had heard about a chap, who worked in our shop and that had been unfortunate and had to 'put up' some of his tools with a pawnbroker, who was noted for his stingy dealings. This had given me an idea, so I walked in to the broker's and handed him out my recent purchase, asking what I could get on it. Well, you ought to see that fellow squint at the 'mike,' run the screw in and out, feel it for shakes, etc. Then he said the tool was old and badly worn, and all he could advance on it was a couple of dollars.

"We argued a while about it, but he wouldn't raise it, so I put the tool back in my big overcoat pocket—'twas near Christmas—and walked toward the door; then I kinder deliberated with myself—ostensibly—went back to the counter and laid down the tool (?) again, saying I guessed I'd have to take it; so he took the case, shook it to see it wasn't empty and handed me out $2.00. I wasn't long in getting away from his place, and of course I never reclaimed the tool, but I would have liked to have seen that Shylock's face when he finally opened the case and re-examined the pledge."

This is the foreman's tale, unadorned, which has several different morals attached if you seek for them. W. E. W.

Duplex Calipers for Tapers.

Editor American Machinist:

Noticing the toolroom taper gage on page 202 leads me to send you the enclosed design, which may prove interesting. The fingers are moved in or out by the right and left screws with the knurled thumb wheels *a* in the middle, and are fastened in the adjusted position by the screws *c*. The slides for the fingers being graduated, or the right and left screws being used as micrometer screws, this, in connection with the length, 6 inches, between the fingers, makes it easy to set the points to any size and also to any given taper per foot.

Neither the graduations nor the micrometer arrangement would be capable, in such a tool of securing the highest degree of accuracy, and for specially fine work the jaws should be set by a standard taper plug. FRANK RATTEK.

Sharp Tools and Thin Chips.

Editor American Machinist:

You can't take a thin shaving with a dull tool!

I wish you would borrow a little of the big type used on the first page of some of our daily papers, and with it print these words in the most conspicuous place in the AMERICAN MACHINIST. Of course "thin" and "dull" are relative terms; but when a tool is so dull that the cutting edge is rounded to a radius of 1-100 inch, it is safe to say that you cannot, with this tool, cut a shaving that is less than 1-100 inch thick. Yet this, in substance, is just what the average mechanic is almost constantly trying to do.

I first realized this in a practical way years ago, when I was running a circular log saw with thirty-six inserted teeth. The power was too light, and we were forced, most of the time, to use the slowest feed, which was 3/8 inch to each revolution of the saw. This made each tooth cut, or try to cut, a shaving 1-36 × 3/8 = 1-96 inch thick. This worked very well when the saw was just sharpened; but the logs were very dirty, and the teeth soon became somewhat dull and then it was a "dead drag" to get through a cut of any depth. One day in the midst of a big log I became desperate, and necessity became again "the mother of invention." A bright thought struck me with such force that I had to act on it at once. We were, as I expressed it at the time, "grinding our sawdust too fine." I stopped the saw and took out each alternate tooth, making no other change. The result was almost magical. We could at once do one-third more work with the same power and three or four times the work with the same amount of filing. We had simply been trying to *take thin shavings with dull tools*, and our sawdust had been *dust* indeed, instead of shavings and clean-cut chips, which the so-called sawdust from any rip saw ought always to be.

This remark applies equally well to the chips from most metal-working tools; and the old saying, "A workman is known by his chips," has more meaning in it than many suspect. My lesson with the log saw has been of much value to me since in designing milling cutters and similar tools, where it is of first importance to have the feed and the number of teeth so proportioned to each other that each tooth can cut a shaving of proper thickness; the most common mistake being in forcing the teeth to take, or *try to take*, too *thin* shavings, with the result that they only *rub off* a certain amount of metal, and, in so doing, unnecessarily strain the machine, dull themselves and waste the power.

You can't take a thin shaving with a dull tool. Every man who is called to finish wrought iron or steel in the lathe must learn this as a first lesson, but some are much longer learning it than others. I remember when a boy, knowing a successful old farmer who could no longer work much himself, but who went with his men to the fields and encouraged them all that he could. In the meadow where he had a number of men mowing with scythes, he would sit under a bush and when they came around would say, "Now, boys, whet often; go sharp. I pay you just as much for whetting as I do for mowing." Now,

some machinists need reminding that the boss pays them just as much for grinding as for using the tools, and that he could well afford to pay them more, for machinists must always cut shavings more or less thin, and they *can't do it with dull tools.* This is why the round-nose tool does not give best results on lathes and planer. There is a place in its curve where it must take, or try to take, a very thin shaving, and it rebels against this.

The other day as I was passing through the machine shop, a lathe hand stopped me and said he was "stuck for a tool" to finish boring a small piece he had in the chuck. The hole must be finished 13-16 inch diameter. He had run through a ¾-inch drill, but must still take out 1-32 inch on each side, and he had no boring tool small enough and long enough for the job. At my suggestion he took a ⅝-inch twist drill and secured it in the toolpost so that the point projected into the hole the same as an ordinary lathe boring tool. He placed one of the cutting lips at the front side of the hole in proper position, and was surprised and delighted to find how perfectly it did the work; and why? Simply because, for once, he had a lathe boring tool properly ground and set. Why will machinists persist in boring with round nose tools in the lathe when they would never think of boring with round-cornered drills?

See that boy chipping the gates off those large castings. He is trying to do a neat job, but in finishing he is holding the chisel nearly at right angles to the work in order to make it "take hold," and is striking twice as hard as he ought to for the thickness of cut he is trying to take. Of course, he has not yet learned that *you can't take a light cut with a dull tool.*

Now, just step upstairs with me into the pattern shop. One of the molders has just returned a new pulley rim pattern 12 inches diameter by 6 inches deep, and is saying: "There is something the matter with this pattern; it *won't draw.*" He and the patternmaker examine it with rule and calipers and find it has the proper "draft," is smooth and well varnished, and the patternmaker (who is a first-class carpenter recently pressed into the service) says "It ought to draw." "But," replies the molder, "it *won't* draw, and if you'll come down to the foundry I'll show you." Just then the proprietor, who graduated from the patternmaker's bench years ago, appears, and, laying a straight-edge across the pattern and holding it up to the light, shows them that the entire surface, inside and out, is full of slight "hollers and bunches."

Now, every real patternmaker knows how they came there, but for the sake of others we will explain it: The pattern is built up of the ordinary segments with "broken joints," so that the grain of the wood is crossed and runs differently on each adjoining course or layer, and in finishing it in the lathe the operator has simply used too little oilstone and too much "elbow grease." In other words, he has attempted the impossible feat of *taking a thin shaving with a dull tool.* His chisel could not cut, but he pressed it against the pattern hard enough to rub off a little dust and in so doing he rubbed deeper in some places than in others, according to the way the grain of the wood ran, and so made a surface filled with slight depressions and elevations which do not appear at first sight, but which prove fatal when the molder attempts to draw it out of the sand.

Every beginner at the wood-working trades goes through a similar experience with his planes before he learns that *you can't take a thin shaving with a dull tool.* And a good many among both wood and metal workers never learn it and so never become the useful and successful mechanics they would otherwise be.

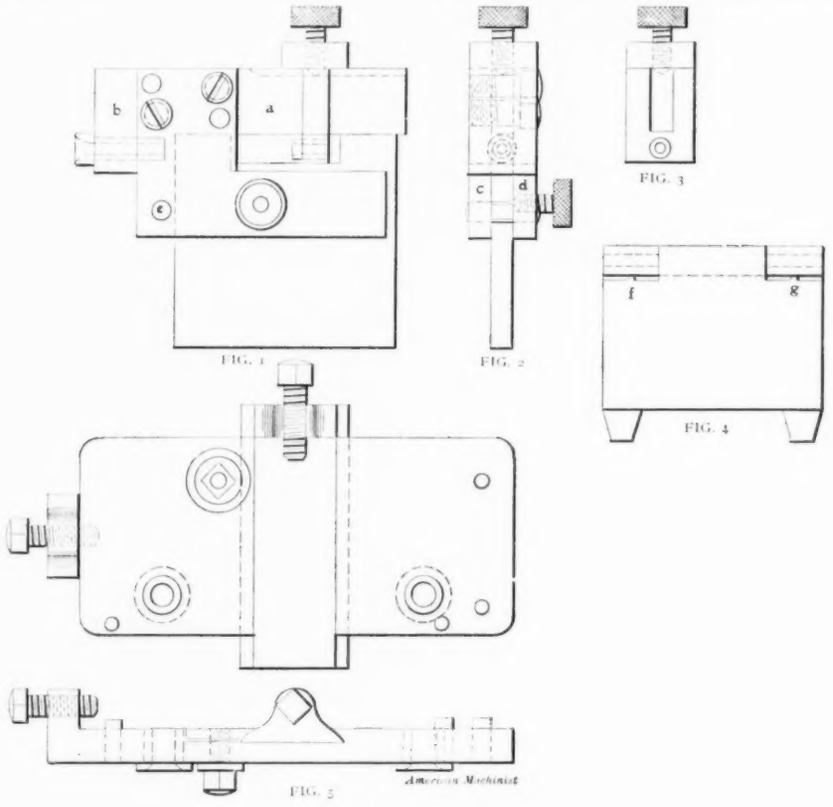
Hackettstown, N. J. J. C. GREEN.

Two Simple Handy Jigs.

Editor American Machinist:

The jigs shown in the accompanying sketches are in daily use in the toolroom of the National Cash Register Company, and every toolmaker will appreciate their usefulness. The first, Figs. 1, 2 and 3, is for drilling the leaf of a jig preparatory to broaching for the taper pin upon which the hinge swivels. This jig is designed to drill a leaf ⅜ inch thick, although there are sizes for each thickness of leaf. The bar *a* is machined ⅜ inch thick and has an overhanging arm *b* to receive the bushing. The sides *c* and *d*, 5-16 inch thick and of the shape shown, are then fastened in place with the screws and dowels. The slide which carries the bushing for drilling the second ear of the leaf (shown in detail, Fig. 3) is slotted a close sliding fit for the bar and is held in place when adjusted by the knurl-head screw, the point of which seats in the slot (detail, Fig. 3).

The leaf is put in with the end against the pin *e* and the top against the bar and is then clamped and squared up on an angle plate and drilled in the drill press. It is then clamped in position on the jig, which has been previously machined as shown in Fig. 4, leaving the stock at *f* and *g* to hold the leaf away from the body of the jig for clearance. These points are afterwards removed.



TWO USEFUL JIGS.

A drill is now run half through from each side, and the parts, while still clamped, are broached for the pin.

We have all, I think, had our experience in swinging this same job upon the face-plate, carefully centering it and just as carefully running the drill through that it may not run off, etc. With this jig the chances of error are reduced to the minimum, besides a great deal of valuable time is saved.

The second jig, Fig. 5, is for drilling milling machine vise jaws, and of this there are also sizes for each size of vise. The body is a forging with an ear on one end through which the screw that binds the jaw passes. The center is dovetailed to receive the slide, which forms the adjustment for the different widths of jaws and is bound when so adjusted by the ring

and screw. The jaw is put in the jig against the pins, the binding screws are tightened and the whole is then placed on the drill, the jig on top and the jaw flat on the table and drilled.

I have worked in toolrooms where a milling machine vise jaw job was almost as bad as a sentence of ten days in jail, for we had to carry around an angle plate weighing, perhaps, 75 pounds, to square the vise up on to spot the holes, the vise weighing perhaps as much more, besides using a lot of spotting drills which were generally in a sorry state of dilapidation. By this method it is not always necessary to handle even the vise.

W. E. CALLAGHAN.

Steam Turbines.

Editor American Machinist:

I suppose the fellow who dreams first is entitled to dream the farthest. It is the habit of the literary world to picture inventors as dreamers. It seems to be argued that those who have given to the world its epoch-making inventions must have known what they were doing, and must have foreseen the effects of their devices far into the future. The boy James Watt watching the boiling tea-kettle is the typical and most familiar of this class of dreamers. If he did dream, and it is morally certain that he didn't, what could his dream have amounted to as compared with the equally possible dream of Hero of Alexandria? It seems to be as clear as that Shakespeare wrote Shakespeare that Hero made a steam turbine, but whether he made the first one or not we may question more and more as we go along. When Hero's turbine first began to turb it would have been very proper for him to have sat down beside it and to have had his doze and his dream. If his dream had been thoroughly done, it should have carried him swiftly right up to the present time and far beyond it, for now quite evidently the day of the steam turbine is fully dawning. The Parsons turbine has been unfortunate in being put into egg-shell boats and coming to grief in consequence, but its efficiency, as also that of the Westinghouse turbine in this country and some others, we may consider to have been fully demonstrated. The latest and completest endorsement of the steam turbine is in the announcement that a contract has just been made in England for ten of them, each of 7,000 horse-power, for one of the great underground railways of London. This business endorsement, it seems to me, completes the evidence for the steam turbine, and it would not be surprising to see it go with a great rush.

This success of the steam turbine must come as a great surprise to many. There are multitudes who could not have believed it possible. I suppose it is a simple fact that not one-tenth of the thought and the experimenting has been expended upon the steam turbine as has been bestowed upon the various types of rotary engine. The rotary engine is discredited everywhere, and this, no doubt, has been a potent deterrent of the turbine. The latter has been regarded as in the same line of development as the rotary engine, but further along; and so it has generally been assumed that as the rotary engine was demonstrably bad and hopeless the case of the turbine must have been vastly more so. The bold men who were not deterred by the rotary-engine slough of despond are to be congratulated upon the firm standing they have secured beyond it.

This success of the steam turbine must be the begetter of another series of dreams, and most likely bad dreams, although not necessarily far-reaching ones. The builders of reciprocating engines may find their occupation going, gone. Of course, coincidently therewith must come an equal development of steam turbine manufacture, but what a change is at once implied in the equipment of the engine manufacturing plant. There will be a lot of machines to be thrown out and new ones to be put in. Not only will less material and less work be required for engines of a given power, but the character of both the material used and of the work put upon it will be changed. The mere abandonment of the reciprocating feature of the machine throws out at once most of the planers and many of the shapers and slotters, while the lathe work also is reduced and the usual dimensions and character of it are changed. The changes implied are not by any means all in the engines themselves, but usually throughout the intermediate mechanism of transmission between the power and the work. The reciprocating engines are comparatively slow moving, and with them there is usually a speeding up through the belts and gearing, while with the steam turbine it is in every case a speeding down instead of a speeding up, so that lighter connections or transmitters of the power will be the rule. The steam turbine, by reason of its high speed, seems to distinctly adapt itself to the requirements of electrical practice, so that it and the electric generator may be expected to be hereafter most intimately associated.

This coming of the steam turbine is another agency that is transforming the routine of the working machinist. The trade, as we all know, has undergone great changes. A half a century ago the ideal work of the machinist apprentice, and indeed of the journeyman, was steam engine work. This was as a rule the best work of the shop, the work with the most distinctive character of its own, and nearly every shop had its share of it. To-day not a quarter of the shops, I suppose, do steam-engine work, and some of the best workmen in the trade have never done steam-engine work. This has come to be so up to the present time without any cessation of the normal growth of steam-engine construction. More and more engines have been built continually, but the growth of the business of machine construction in general has been so rapid and has extended in so many and so diverse directions that the steam engine has ceased to be the central and most prominent part. There has been up to now no essential change in the component parts of the steam engine. They still have their cranks, crossheads, slides, connecting rods, eccentrics and all the rest of the familiar pieces. The steam turbine threatens now to drive out all these, and the special lines of skill which they called for must become scarcer and there will be those who will be whining more persistently than ever about the decadence of the trade and the scarcity of the old-time skill. It may be well to remember that it is the new skill and not the old skill that is wanted, and the new conditions will not fail, as I believe they are not failing, to develop and supply it. I may be a little ahead of things in talking in this strain about the coming of the turbine, but just think of conservative but well-informed engineers planning the installation of 70,000 horse-power of steam turbines not at all for experiment but for every-day business, and the money all ready for them. With the railway trains that they are to drive chasing me, I am not likely to be far ahead for long.

TECUMSEH SWIFT.

"X-Ray" Pattern Work.

Editor American Machinist:

The men in the shop called it the "X-ray" trick. I was making a number of pulleys with five, six or seven arms. Each pattern was made in halves for the molding machine, only one half pattern was made, and this had to be very accurate, so as to reverse. I made the pattern as nearly as possible correct, but the foreman had a slight doubt about it, and he told me to lay it on a piece of drawing paper and cut out the arms and see if it would reverse. I did this with a number of them and found it a great lot of trouble to get the paper arms cut out exact, and when the cut paper was left over night it would change its shape. I thought the thing over to see if I could not do it some other way. I took a piece of ordinary drawing paper, placed it on a flat surface and then placed the pulley on the paper and traced the arms and rim. After tracing, the paper was taken to one of the windows and put up flat against the glass and then the pulley pattern on the paper. In this way I could do in two minutes what before took a quarter to half an hour, and with far better results. Now all match patterns are tried in this way.

BILLY MURPHY.

To write on glass: moisten the surface with strong vinegar and write with an aluminum point. Infinitesimal particles of the soft metal are left adhering to the glass and the writing is fairly permanent.

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The Machinist's Eyes.

The article in another column by Mr. Ridderhoff may appear to some of our readers as "out of our line." The eye is at once the most wonderful and the most important of our bodily organs, and to none is it more important than to the machinist, patternmaker or draftsman. Our reason for publishing this article is that defects in the eye are often unsuspected by those who have them—astigmatism being, perhaps, the most common defect which is thus unsuspected. The difficulty is that we can see through no eyes except our own, and thus we have no standard of comparison. We go through life, or at least through the first half or two-thirds of it, thinking that our vision is good, when, could we but see through a really perfect eye, we would, in many cases, learn at once that our supposed good vision is in reality very poor. Two of the editors of this paper have had this experience. In both cases the vision was, so far as known, clear and perfect. In one case there was a smarting of the eyes when reading in the evening, and in the other there was an annoying discharge of tears in cold weather. Eventually these annoyances led to an attempt to get help, and in both cases the eyes were found to be astigmatic. When suitable glasses were made and used both parties found that they had never known what clear vision meant. In one case the first help obtained was of the incompetent kind referred to by Mr. Ridderhoff, and the first glasses obtained were unsuitable. No one should trust the traveling spectacle peddler or the ordinary optical store, but go to an oculist, who will apply suitable tests and prepare a prescription which may or may not be such as to be filled from glasses kept in stock. Glasses for simple far or near sight can usually be obtained from stock, but for astigmatism they must usually be ground to suit the oculist's prescription, and when astigmatism exists in combination with near or far sight, as is frequently the case, the attempt to find suitable glasses in stock is hopeless.

A machinist's work is particularly trying to astigmatic eyes. The habitual use of graduated scales of any kind is trying enough, but when, as with most scales which machinists have to use, the lines are engraved in metal without contrast of color, the condition is still more trying. A machinist who finds that such scales are more distinct in some angular positions—vertical, horizontal or inclined, as the case may be—than others, may feel pretty sure that he has astigmatism, though the opposite experience should not lead to the opposite conclusion. No one but an oculist can determine with any certainty whether one's eyesight is good or not.

Defective eyes frequently make efforts to indicate their need of help, giving rise to symptoms which would attract an oculist's attention at once, but which, to the average man, appear to have no connection with the eyes, and hence serve no purpose in directing attention to them. We have known of two cases of violent periodical headaches which physicians were unable to help, but which disappeared as by magic when properly fitted eyeglasses were adopted.

Mr. Ridderhoff has charge of a machine shop and knows the importance of good eyesight to machine constructors. He is also a competent graduate optician, and is therefore, we think, specially qualified to write for machine constructors about eyesight and the care of it.

Taxation of Corporations.

In several States, particularly in New York and Ohio, bills are being or have been recently considered, relating to the taxation of corporations and an effort is being made to more heavily tax corporations generally. For some reason those who realize or believe that the present systems of taxation are inequitable and unfair to industry and commerce, seem to think that if stock corporations could be more heavily taxed or taxed out of proportion to other business enterprises the problem would be solved. We confess our inability to see the point in this. Corporations are after all nothing more than a form of business partnership. It frequently happens that a business that has been carried on for years as a private partnership is incorporated simply as a matter of convenience to admit to partnership employees, such as superintendents and foremen. It remains to all intents and purposes a partnership as before and the business is carried on in exactly the same way as before without additional profits or means of making profits, the only reason for the change being simply the convenience of apportioning stock among the different owners. If there is any reason why such a corporation engaged, let us say, in a manufacturing enterprise, should be more heavily taxed or that it should bear a special tax as a corporation not borne by a similar manufacturing enterprise conducted as a private partnership, we would like to know what such reason can be. Where a corporation enjoys some special privilege conferred upon it by a community; where it owns or makes use of some special franchise or property belonging to the public, it should pay either by purchase or by taxation for such use or for such special privilege, and an individual should pay exactly the same for a similar privilege or use of public property. The mere fact of being a corporation or of being a private individual or a partnership of private individuals it seems to us should make no difference whatever and we believe that the officers of incorporated companies carrying on manufacturing business should be more active than they are in opposing legislation based upon unreasoning and undiscriminating hostility to corporations as such.

Technical Publications.

"The Premium Plan of Paying for Labor." By F. A. Halsey. 20 6½x9½ inch pages. The Sibley Journal of Mechanical Engineering, Ithaca, N. Y. Price, 50 cents.

This is a pamphlet reprint of the entire lecture of which a portion was given by us at page 292. It is regarded by its author as the best and most concise presentation of the plan which has been published.

"Easy Lessons in Mechanical Drawing and Machine Design." Part 20. By J. G. A. Meyer and C. G. Peeker. The Industrial Publication Company, New York. Price, 50 cents.

We have from time to time, as they have appeared, noticed the various parts of this work of our former associate editor and his assistant. The present part completes the work, and we cannot do otherwise than repeat the favorable opinions of its value that we have already given. In extent and quality of execution, it stands alone among works of its class. As is well known, Mr. Meyer suffered a stroke of paralysis when the book was about three-fourths finished, notwithstanding which he persisted in the work and thus no doubt hastened the end. Mr. Peeker, as his assistant, was conversant with his plans and has carried the work to completion at Mr. Meyer's expressed wish, and as a labor of love. The present part contains a preface to the second volume which is a touching tribute to Mr. Meyer's memory.

"Principles of Physics." By F. M. Gilley. 552 5x7½-inch pages, with 511 illustrations. Allyn & Bacon, Boston. Price, $1.30.

This book is intended as a text-book for high and preparatory schools, but it is equally well adapted to home reading. It has several prominent features, among which are the simplicity of its language, the attention given to the explanation of phenomena of every-day life, and the simplicity of the apparatus described. The author has pronounced talent in devising simple apparatus and a very large proportion of the devices shown can be made by anyone who is likely to care enough about it to try. To most our readers the sections on Mechanics and Heat will be most useful. From the former accurate and correct knowledge can be obtained of such things as density, specific gravity, the composition of forces, work, energy, weight and mass, and from the latter of the properties of steam, latent heat, absolute temperature, the relation of heat and work and the action of steam in the steam engine. To other readers the section on Electricity will be more interesting, and from it the essentials of that science may be learned. The whole book is strictly modern and contains a large number of questions and problems. We know of no book which can be more confidently recommended to the ambitious mechanic, young or old.

A New Metal Working School.

It is always a grateful task to speak of the Hebrew Technical Institute, of this city, for it must be considered one of the most practically successful of beneficent enterprises. This institution educates boys of limited means in such studies as will best fit them for success in mechanical trades. It does not aim to produce professional men. Since 1883, 395 boys have been regularly graduated, 70 per cent. of whom are known to be employed in mechanical work, and a tabulated report of the average earnings of the members of the several classes shows them to have taken highly remunerative positions. Thus the class of '86 shows average earnings of $35 per week; '90, $32; '95, $18, and 1900, $8.50. Boys are taken at the age of twelve and a half years, able to pass an examination equivalent to that for the third grade of the grammar schools of New York. Tuition, books and tools are absolutely free to all. A warm lunch is provided at small cost. The physical condition of the boys is under constant supervision and bathing forms a regular part of the curriculum. The course occupies three years and the boys are expected to take the full course. For the first two years all pursue the same studies and in the last year, while much of the work is common to all, each boy receives special instruction according to his special talents in machine work, practical electricity, pattern work or mechanical or architectural drawing.

On the evening of March 26 a new six-story building, the gift of Mr. and Mrs. Lucas A. Steinam as a memorial of their son, was dedicated with interesting ceremonies. This building is devoted entirely to the various shops of the metal-working trades, and all departments were shown equipped and all in operation with the boys in their several places. We can only say that we have never seen a more perfectly and completely equipped plant for any purpose. The new structure is six stories in hight, fireproof throughout. In the basement is the heat, light and power plant. A Corliss engine and a Nash gas engine are the motors. The first floor comprises a neat auditorium. The second floor is the Lucas A. Steinam metal-working shop, completely equipped with vises, lathes, planer, milling machine, gear cutter, all necessary appurtenances and the special tools, calipers, squares, gages, sufficient to supply each individual worker. Third floor is the Dienchen Lauferty patternmaking shop, endowed by Mrs. Steinam in memory of her mother. Fourth floor, the Bernhard Mainzer joinery shop. Fifth floor, the Samuel Lewisohn mechanical drawing department. Sixth floor, the Charles Lauferty forge shop and the molding and casting room. The utmost liberality is evident everywhere in providing every useful accessory, while nothing is given to mere display. Fine specimens of the work of the students are exhibited in each department.

A Star Admiral.

Rear Admiral George W. Melville, Chief of the Bureau of Steam Engineering, was advanced for his distinguished services with the Jeanette Arctic expedition, but he has not been borne on the naval list as an additional number, as a recent act of Congress contemplated. The omission has been brought to the attention of the Secretary of the Navy, who has rendered a decision in the matter. It is held that as Admiral Melville's advancement was made while he was an officer of the Engineer Corps, and before his transfer to the line, he cannot be borne on the list as an additional number. The Secretary has directed, however, that Admiral Melville's name shall be marked in the naval register by an asterisk, indicating a foot-note which shall explain that he was advanced for his services in the Arctic.

Inventors and the Government.

In a Federal Court at Utica, N. Y., Judge Coxe has ruled that an inventor has no redress against the Federal Government in cases of patent infringement. The suit was brought by the International Postal Supply Company of New York against the postmaster at Syracuse. A canceling machine for letters is used in the Syracuse, as well as all first-class postoffices, the patent right being held by the complainant. This ruling by Judge Coxe, in which the complaint was dismissed, is in accord with decisions of the United States Supreme Court, which hold that owners of a patent cannot enjoin government officers from using the invention. Judge Coxe, in his decision, says it is illogical for the government to give an inventor exclusive rights and then render its acts nugatory by invading the patent rights. The court suggests that Congress, in view of the decision of the United States Supreme Court, take some action to provide adequate relief for this class of inventors who devote their energies to inventing appliances which facilitate the work of the government.

Explosion of a Piston.

A friend sends us a clipping from a Detroit paper containing an account of an explosion of a piston which was being heated in the works of the Riverside Iron Works by George M. Scholes, assistant superintendent. The piston, it seems, was hollow, and at the moment when Mr. Scholes had his hands upon it it exploded, shattering both arms so that one of them had to be immediately amputated, but there is hope of saving the other. This simply adds to the long list of such cases and again emphasizes the fact that no hollow piston should be heated without first being

sure that there is a vent for the escape of any possible gas or steam that may be generated within it. We have published numerous accounts of such explosions which have occurred where pistons have been either heated over a fire or thrown into cupolas, and those who read the literature of the machine business should be well informed regarding the extreme danger of such a course.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

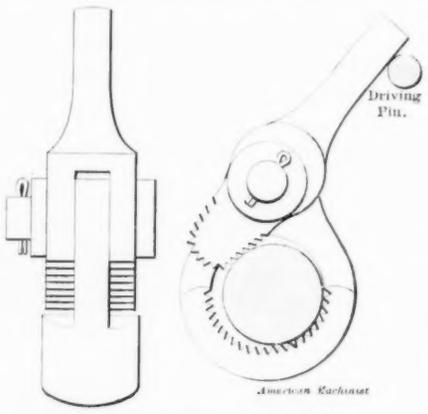
(5) J. S., Coventry, England, asks: What liquid do you recommend for cutting phosphor bronze on small automatic machines, such as are used in machining bright accurately finished work, such as balls, rollers, etc.? A.—We have referred this question to the Brown & Sharpe Manufacturing Company, who reply as follows: "We have not had much experience in working phosphor bronze or gun metal in our automatic screw machines, but for what little we have had we have always used good lard oil. We know of nothing any better. Almost any other liquid is likely to be detrimental to the working of these machines in causing the bearing parts to become gummed to a greater or less extent. In working these metals in our other machines we work them dry or use, as noted above, good lard oil."

(6) G. E. F. encloses a cut of a lifting jack with a compound or "Hunter" screw the diameters of which he gives, the pitches being 3½ and 3 per inch. He wishes to know how much this jack will lift with 100 pounds pull at the end of a 3½-foot lever. A.—We do not believe that anyone can tell how much it will lift except by experiment. Theoretically the jack will lift 550,000 pounds, but practically it will lift very much less than that, because the friction of such an arrangement is, at the maximum load, very great. In fact, probably something like 75, 80 or even 90 per cent. We arrived at the amount given above by considering that the difference in pitch between the two threads is 0.048 inch, which of course is the amount of the vertical lift of the load per turn of the lever. The force of 100 pounds moves at each turn a distance of 22 feet and the proportion between these two distances and the power applied gives the figures named for the weight that will be raised theoretically; from which deduction is to be made for friction as mentioned above.

Some New Things.

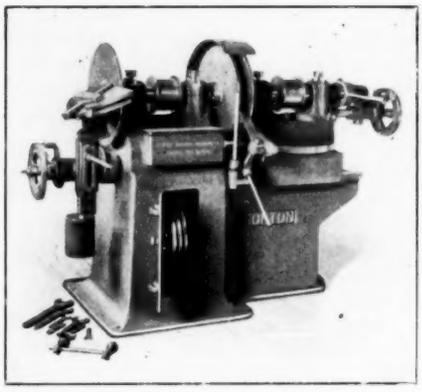
A SELF-ACTING LATHE DOG.

The cut herewith, reproduced, with changes, from *Engineering*, London, shows a lathe dog or driver which requires no wrench to fasten it. The driver is simply slipped upon the end of the piece to be driven, and the toothed ends of the driving lever bite the piece and drive it securely. The driver as made takes sizes as small as about one-half the diameter of



A SELF-ACTING LATHE DOG.

the hole up to the size as shown. The greater the resistance, of course, the stronger the bite. The drive may be in either direction, but not in both. This driver is made by George Turton, Platts & Co., Sheffield, England.

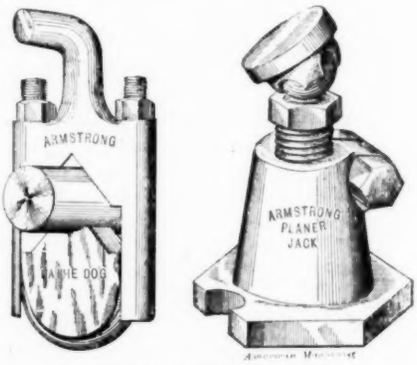


IMPROVED DISK GRINDER.

The George Gorton Machine Company has brought out a new universal flat surface grinder. The machine, as shown in the illustration, has in addition to the well-known features of their regular type of grinder, a swiveling head mounted on a saddle at the right-hand end of the machine. This head, which is graduated to 30 degrees each way, can be set with its disk either parallel or at an angle with the opposite disk. Or it may be swung completely around and operated as an independent grinder.

It will be seen that this head can be set so that two sides of either a straight or a taper piece can be ground in one operation. The arbor on which is mounted the right-hand disk, has an end travel of about an inch, and is moved by means of the hand lever shown at the extreme right. The forward movement of the arbor is regulated by a stop which can be set, through the medium of the hand wheel, to one thousandth of an inch. The disks on this machine are 18 inches diameter and can be moved far enough apart to take in work 12 inches wide. The pedestal is ribbed inside and is very rigid.

The weight of the machine is 3,000 pounds.

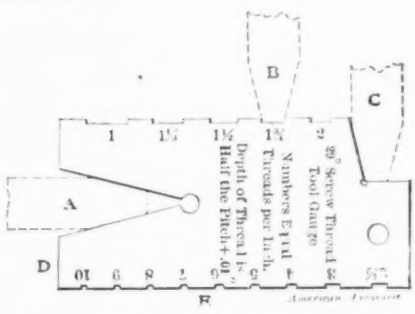


LATHE DOG AND PLANER JACK.

We show two new tools recently put on the market by Armstrong Bros. Tool Company, of Chicago.

The lathe dog, which has a body of cast steel, is fitted with a clamp which is drawn to place by a loosely fitting U-bolt, threaded at the ends to receive a pair of case-hardened nuts. This dog, which has a large range of adjustment, is made in seven sizes, taking in work from ⅛ to 5 inches diameter.

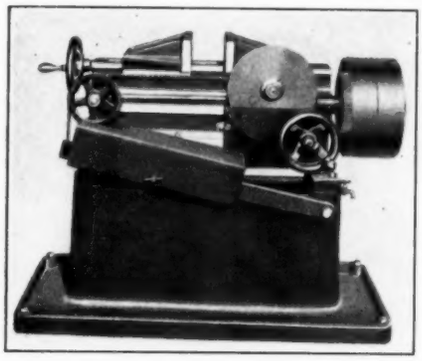
The planer jack consists of a malleable iron base faced off true on the bottom, carrying a steel jack-screw fitted with a tilting cap. The hub of the jack is split and is fitted with a case-hardened binding screw, by means of which the jack-screw is clamped securely in any position. The jack-screw has a hexagon neck for a wrench, and to its head is attached by ball and socket arrangement the malleable iron tilting cap. This cap is faced off on top, and, as it is free to rock in any direction, will accommodate itself to any uneven or angular surface. The jacks are made in four sizes.



IMPROVED 29° SCREW THREAD TOOL GAGE.

The cut shows an improved gage, made by the Brown & Sharpe Manufacturing Company, for grinding and setting the tool used for cutting Acme standard screw threads. The manner in which the gage is used is clearly shown in the illustration. At *A* is a slot having an included angle of 29 degrees. This makes it possible to test the angle of any tool regardless of pitch. The method of testing the width

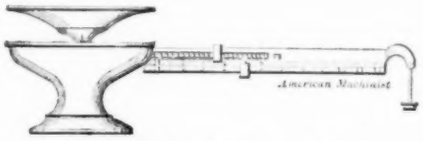
of tools at the point is shown at *B*, a series of notches being provided for the various pitches. When grinding the point of tool to width, the angle of side with point can be tested as at *C*. In setting the tool in the lathe, the end *D* of gage can be placed against the face-plate, or the side *E* against the work, the tool in either case being placed as at *C*. It will be seen that this gage is much more convenient than the older style, in that it admits of a tool being more readily ground, and does away with the necessity of a separate setting gage. Furthermore, the form of the gage admits of the addition of three pitches.



A NEW SHOP COLD SAW.

The accompanying half-tone illustrates a new metal saw which has been put out recently by the Reade Machinery Company, of 410 American Trust Building, Cleveland, Ohio. The saw is intended for cutting up stock and especially for doing the class of work which is now done with power hack-saws.

The leading peculiarity of the machine is the weight feed which is obviously well suited to the requirements. In cutting round bars the duty on the saw is kept constant as the saw sinks into the work, the feed being fast at starting and finishing, and slow in the middle, as it should be, since the pressure on the saw being constant the rate of feed varies with the length of the cut. The rate of feed is adjusted for heavy or light work and for the hardness of the material by adjusting the weight on its lever. The saw runs in an oil trough and the vise is adjustable for cutting at an angle.



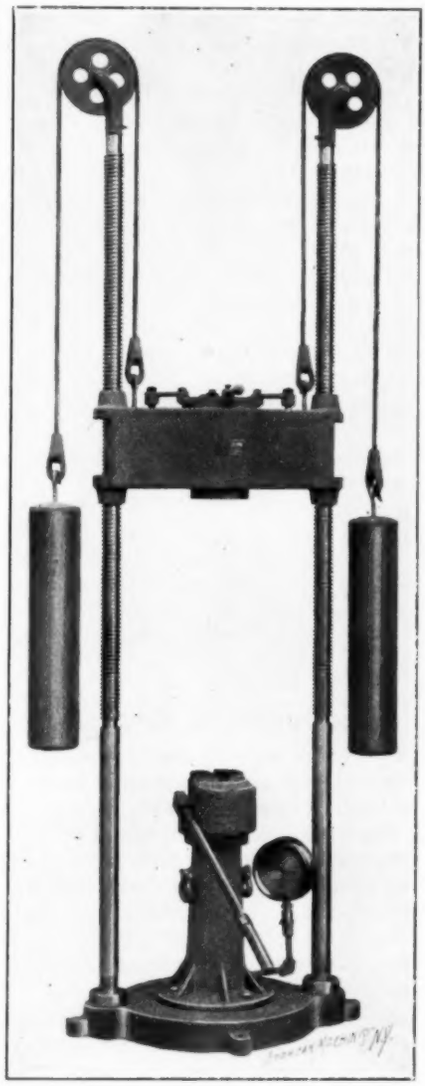
WEIGHING AND COUNTING MACHINE.

Joseph S. Cortelyou, of New York city, has recently patented a machine for weighing and counting small work—such, for example, as comes from the screw machine or punch press.

The machine is in general appearance much like the ordinary scoop scale. The beam is graduated to give readings, not only in avoirdupois, but also in troy and the metric systems.

The pan is held in a support which can be moved back and forth by means of the screw shown in the slot in the beam. This screw, being right and left hand, slides the balancing weight in the opposite direction to that in which the pan travels; therefore at whatever point the pan is located it will always be in balance.

The small scale shown in the cut, weighing to 25 pounds avoirdupois, or the equivalent in the other systems, has on its beam a series of numbers ranging from 1 to 5,000. By adjusting the pan to the proper position for the work in hand any number of pieces up to 5,000 can be counted.



A NEW ARBOR PRESS.

A novel arbor press is made by the R. K. LeBlond Machine Tool Company, of Cincinnati, Ohio. The half-tone shows this machine so clearly that little description is necessary. The counterbalanced head is quickly placed in position and rigidly clamped to the threaded uprights by means of half-nuts operated by the lever at the top of the head. The Watson-Stillman jack at the base of the machine has a movement of 12 inches and a capacity of 40 tons. The press will take in work up to 36 inches diameter.

Steam Engine Wreck.

We have information of a very complete stationary engine wreck which occurred recently in a paper mill at Kalamazoo, Mich. The engine was comparatively new and the initial accident was the bursting of the flywheel. One of the pieces went over the building to a distance of about 400 feet. Another piece broke through the end of the engine-room. Another piece went up and came down directly upon the engine itself and completed the general wreck.

Civil Service Examinations.

The United States Civil Service Commission, Washington, D. C., announces the following examinations: May 6-7, Examiner of Surveys, General Land Office, at $5.00 a day while employed; same dates, Junior Architectural Draftsman, Supervising Architect's Office, Washington, at $840 a year; May 6-7-8, marine draftsman, Lighthouse service. The examinations are held at many different places throughout the country. Those wishing to compete should obtain application blanks, manual of examinations, etc., from the Commission without delay.

It is reported from Vienna that a resident of that place, named August Matitsch, has devised a lace-making machine, which is said to produce lace which is undistinguishable from the hand-made article. Many attempts have, we believe, been made to construct such a machine, but heretofore without success. It is now believed, however, that a machine has been devised which will be practically successful and will supersede hand labor in this work.

A strike occurred the other day in Jersey City for a somewhat unusual reason. A certain bridge company is erecting several bridges over there. The company employed union men on several bridges, but on one they employed non-union men. The non-union men and the union men got fighting and a day or two afterwards the non-union men struck for higher wages, claiming that if they were expected to fight as well as to work they must be paid for it.

Personal.

Frank V. Bartlett, who for a considerable time has been general manager of the Pratt & Whitney Company, Hartford, Conn., has resigned to accept a similar position with the Ideal Manufacturing Company, of Detroit, Mich.

A. J. Strong, a valued contributor to our columns, who has for five years past been

with the Western Electric Company in New York, goes to Dayton, Ohio, where he will be designer of special tools and fixtures for the National Cash Register Company.

J. F. McNutt, formerly of Cincinnati, and at one time superintendent of the Harris Automatic Press Company, of Niles, Ohio, has located in Springfield, Ohio, where he will do a light manufacturing business, particularly in parts and specialties connected with the automobile industry.

Loring Coes, president of Coes Wrench Company and Loring Coes & Co., of Worcester, Mass., on the 22d of April, will celebrate his ninetieth birthday. He is believed to be the oldest living manufacturer of hardware in the United States, and is still active and hearty, going to his office regularly and looking after his business interests, etc.

Obituary.

William R. Snead, president of the Snead & Co. Iron Works, of Jersey City, N. J., died March 27. Mr. Snead was a graduate of the Stevens Institute of Technology and succeeded his father in the management of the works which bore the family name.

Albert Judd Blakeslee, inventor of a steam pump and a veneering machine bearing his name, and president of the Blakeslee Manufacturing Company, DuQuoin, Ill., died March 9, seventy-eight years old. His father was a pioneer machine-shop proprietor of Illinois. The Blakeslee Manufacturing Company was established in 1862.

Henry Martin, a large manufacturer of brick machinery, died at Lancaster, Pa., March 4, seventy years old. M. Martin came to this country from Derbyshire, England, in 1858, and early in the 60's made the model of his first brick machine. After a start in New York and a disastrous failure following the panic of 1873, he began again in a small way at Lancaster and developed an immense business in his special line.

Joel Knapp, an old-time machinist, died at Lowell, Mass., March 22, sixty-seven years old. He was an apprentice at the Lowell Machine Shop and worked at his trade, part of the time in California, until the Civil War, when he enlisted and served in the engineer corps. After his return he worked for twenty-two years in the Lowell Machine Shop, twenty years as a contractor, and in 1885 engaged in other business for himself. His career tells us where some of the old machinists go.

Aaron French, founder of the A. French Spring Company and president of the Steel Spring Company of America, died at Pittsburgh, Pa., March 24, seventy-eight years old. Mr. French began to work as a blacksmith's apprentice when thirteen years old. The horseshoeing part of the business got him into stage driving for a time. When twenty years old he went to school for a year or more in Ohio. Then he got into wagon building at Carlyle, Ill., and after four years of ill-health he found employment with a railroad company in bridge work. Then he was in charge of railroad shops as master mechanic for several years. In 1864, after serving as sheriff of Racine county, Wis., he engaged in the manufacture of springs at Pittsburgh with Calvin Wells as partner, using from the beginning the now well-known firm name of the A. French Spring Company.

John B. Crocker died at Hamilton, Ohio, March 22, forty-nine years old. Mr. Crocker became connected with the engineering department of the Niles Tool Works about twenty-two years ago, upon the completion of his college course in mechanical engineering. He was for a number of years chief draftsman of the establishment and he had aided largely in the developing and perfecting of the large and varied line of machine tools. Mr. Crocker's health began to fail five years ago, and it became necessary for him to try a change of climate. Later he was sent to Berlin, where he assisted in planning the great "Deutsche Niles" works, and he returned apparently much improved and took up again active engineering work, but after four months of wasting away consumption claimed him. Mr. Crocker will be remembered by many readers of the AMERICAN MACHINIST as a contributor of interesting and valuable articles. He was a man of rare engineering ability and of lofty ambition. He was unusually beloved by his associates and his untimely end is deeply mourned by those who knew him. Mr. Crocker had been a member of the American Society of Mechanical Engineers since 1890.

Commercial Review.

NEW YORK, Monday, March 31.

MACHINE-TOOL MARKET, RAILROAD AND ELECTRIC WORK, ETC.

The activity in business continues with little indication of abatement. Some hints of recent slackening in a small local way there are indeed, but when a prominent Liberty street house states that it expects the present month to break the record in its trade, one is apt to set little store by the more pessimistic rumors. Important enterprises, especially the equipment of railroad shops, still occupy a focal point of interest. Prices of machine tools are generally steady since the advance in certain lines of milling machines a few weeks ago. We are told that some minor changes have taken place in the market, but not of enough consequence to name. There continues to be considerable complaint about deliveries and for some of the most popular tools a portion of the business that otherwise would be taken has to be let slip by. There is noted in one quarter a difficulty in obtaining lathes. The scarcity of second-hand tools, especially up-to-date ones, while it may be discouraging to those who are wont to traffic in this line or who are on the hunt for bargains, is an excellent proof of the prevalent industrial condition. It shows how few shops are having to abandon business.

The Pennsylvania Railroad is buying tools frequently and liberally. The specifications from this road which one house has now before it are estimated off-hand to foot up to $100,000.

There is some apprehension of a renewal of the machinists' strike for a nine-hour day this year. It is not, however, expected to spread over such an area as last year. Trouble is feared at Worcester, Mass., while at Cincinnati and in New York city the sky looks clearer.

It is somewhat singular that two ordnance companies having plants in Connecticut and whose names have had a good deal of mention in common should both be falling into financial difficulties. The Driggs-Seabury Gun and Ammunition Company has gone into the hands of a receiver on the instance of Louis H. Driggs, who claims $34,000 due him in royalties on inventions and alleges that the company's liabilities exceed its assets. The American Ordnance Company is being subjected to attachments and a reorganization is talked of. The two concerns have been in sharp competition and it may be a case of Kilkenny cats. Only a few weeks ago it was reported that the American Ordnance Company had swallowed the other, but this was quickly denied.

As an instance of the high prices irregularly being paid for spot iron for melting, a foundry in this vicinity, which uses some 40 tons a day, has been buying iron scrap at fancy figures, ranging up to $22 or more a ton. It is learned that a buyer of railway rails of 70 or 75 pounds weight was recently forced to turn to the Belgian market to fill his requirements, the American mills being sold out for so many months to come.

Indications at Scranton, Pa., are that the Delaware, Lackawanna & Western Railroad is soon going to carry out a project to build new shops there which will cost $800,000 and employ 1,500 men. Land has been purchased of the Lackawanna Iron and Steel Company, and the latter asked to vacate by April 15. It is expected that the work of building passenger coaches, etc., now done at Dover, N. J., may be transferred to Scranton. The new shops will employ the electrical power distribution system, and that system as applied at Scranton will possess a leading feature of merit which it has not exhibited in other places where it is installed; for, according to a Scranton newspaper, the advantage of the method is "that when one machine, saw or lathe is out of order, it will not be necessary to stop all of them to make repairs."

It may be mentioned that on another plot of land at Scranton previously occupied by the Lackawanna Iron and Steel Company, a large power plant is to be erected for the Scranton and Pittston Rapid Transit Railway. This will occupy a building 190x160 feet, and with the equipment will cost upwards of $1,000,000. The contract to equip and build it has gone to the Westinghouse people. It is said that they are interested in the road and are intending to make it an advertisement for some system of theirs—just what system is being kept secret.

The New York, New Haven & Hartford road, which has lately ordered wood-working and other machinery for Readville, Mass., is shortly to place contracts for equipment for a marine repair plant at Newport, R. I., which are estimated as amounting to $100,000. Among the machines that are to go in the Readville plant are some car-wheel lathes, a car-wheel borer and four steam hammers (of from 1,100 to 3,500 pounds, aproximately) to be built by the Niles-Bement-Pond Company. Specifications for the Newport equipment are now out.

A new freight-car building and repair shop is to be added to the plant of the Boston & Albany in West Springfield, Mass. It is understood to be one of a number of additions to this plant which will be built to accommodate machinery from the Rensselaer (N. Y.) and Allston plants.

Car shops are proposed to be built for the Rochester (N. Y.) & Eastern Rapid Railroad Company, and an attempt is being made to secure them for Geneva, N. Y.

A block of land has been bought in Jersey City for a terminal and power-house site for the trolley car tunnel across the river to New York, and a location for the New York terminal has also been purchased. This is the tunnel that was started fifteen years ago, more or less, and which after years of labor and mortality dropped into innocuous desuetude. About the time that the proposed Pennsylvania Railroad tunnels were announced, the project of completing the old one for connection with the trolley roads in Jersey City developed also. The concern which is carrying out the enterprise is termed the "New York and New Jersey Railroad Company."

Wm. H. Eddy & Co. and N. A. Lombard Company, Worcester, Mass., have consolidated under the name of N. A. Lombard Company, and will manufacture an up-to-date line of turret lathes and foundry molding machines. Their capacity has been greatly increased. E. H. Ingram is president and J. J. Wehinger is secretary and treasurer.

The Springfield Armory contracts have, in great part at least, been awarded, several different concerns located or having offices in New York receiving portions.

Inasmuch as the Australian market is a growing field for American iron products it is well to note certain favorable changes which have lately been made in the Australian tariff by the House of Representatives. The following are the old and new rates on Division VI. metals and machinery: Moldboards, sheep-shearing machines, engines (portable) fixed on a locomotive boiler horizontally, with wheels and shaft suitable for transport, traction, and oil engines, formerly 15 per cent., now free; horseshoe nails, formerly 7s. ($1.70) per cwt., now free; tanks containing goods or empty, formerly 3s. (73 cents) for every hundred gallons or part thereof, now free; boilers, pumps, machinery, n. e. i., formerly 25 per cent., now 20 per cent.; screws, n. e. i., formerly 25 per cent., now free; axles, springs, formerly 25 per cent., now 15 per cent.; mixed metal ware, formerly 25 per cent., now 15 per cent.; plated ware, including plated cutlery, formerly 25 per cent., now 20 per cent.; manufactures of metal, n. e. i., formerly 25 per cent., now 20 per cent.; engines, n. e. i., formerly 25 per cent., now 20 per cent.; cartridge cases, empty or capped, and wads, formerly 25 per cent., now free; rolled iron or steel beams, channels, joists, girders, columns, trough and bridge iron or steel not drilled or further manufactured, shafting, cold rolled, turned or planished, also bolts and nuts, formerly 20 per cent., now 15 per cent.; barbed wire, formerly 20 per cent., now 10 per cent.

CHICAGO MACHINERY MARKET.

A large seller of electrical machinery remarks that last summer the demand for small motors was so great that deliveries were backward, whereas reasonably prompt shipments could be made for large generators, the shop capacity in that department not being so crowded. At present the conditions are just the reverse. The shop department devoted to small motors is hungry for orders, while that producing large generators has orders booked ahead. The impression exists among some factors of the Western trade that business in electrical machinery is not quite so lively as it was several months ago, but this is doubtless at least partially due to the fact that production is so vastly increased.

The inquiry for shop equipments seems to be as large as ever and a fair amount of business is being closed every week. The equipment for the new packing plant of Armour & Co., Fort Worth, Tex., was secured by the Keystone Electric Company. It calls for about 600 horse-power in both generators and motors. The American Well Works, Aurora, Ill., have bought an electrical equipment, consisting of a 100-kilowatt generator and 100 horse-power in motors. The Youngstown Steel Casting Company, Youngstown, Ohio, has installed a 100-kilowatt generator and motors corresponding. At the new plant of the Atlas Engine Works, Indianapolis, Ind., a 500-kilowatt generator and many motors are to be installed and the old shops will be equipped with electricity later. The Hooven, Owens & Rentschler Company, Hamilton, Ohio, manufacturers of the Hamilton-Corliss engines, will operate the entire plant electrically, buying a 500-kilowatt generator and a complement of motors. The Morden Frog and Crossing Works, Chicago, have contracted for a 100-kilowatt generator and motors of 100 horse-power. The Hammond Packing Company, about to remove from Hammond, Ind., to Chicago, will equip the new plant electrically. The Henry Vogt Machine Company, Louisville, Ky., is placing an order for a 200 horse-power generator and motors to operate the plant electrically.

The Crocker-Wheeler Company has sold four motors, aggregating about 175 horse-power, to Marshall Field & Co., for their new Chicago building under construction; also an equipment for W. A. Wagner & Co., printers, Freeport, Ill.

Among recent orders taken by the Sprague Electric Company are the following: For Las Vegas, N. M., street railway, one 200-kilowatt generator and one 150-kilowatt generator; Chillicothe, Ohio, Street Railway Company, one 300-kilowatt generator; Wm. Focke's Sons Company, Dayton, Ohio, 50 horse-power generator and motors; Cosmopolitan Power Company, Chicago, one 100 horse-power generator and corresponding motors for factory equipment; Ohio Powder Company, Youngstown, Ohio, 100-kilowatt generator; Wm. Tod Co., Youngstown, Ohio, 200-kilowatt generator; National Printing and Engraving Company, Chicago, 100 horse-power generator and twenty-two motors for new plant at Niles, Mich.; 200 kilowatt generator for Frank Sturges power building, Chicago; Lima Locomotive and Machine Company, Lima, Ohio, 100-kilowatt generator and five 30 horse-power motors; Atlas Portland Cement Company, Hamilton, Mo., three 400-kilowatt generators; Adams & Westlake Company, Chicago, 150 horse-power generator; Nelson Morris & Co., 500 horse-power generator and corresponding motors.

Quotations.

NEW YORK, Monday, March 31.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$18 65 @ $19 40
No. 2 X	18 15 @ 18 90
No. 2 plain	17 65 @ 18 40
Gray forge	17 15 @ 17 90

Alabama Pig, New York delivery:

No. 1 foundry, or soft	16 25 @ 18 25
No. 2 foundry, or soft	15 75 @ 17 75
No. 3 foundry	15 25 @ 17 25
Foundry forge, or No. 4	14 75 @ 16 25

It is not to be understood that spot iron can be obtained even at the maximum figures quoted, nor that any Southern can be

bought at the minimum for earlier delivery than the latter half of 1903.

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. in carload lots. Smaller quantities from store, about 2.10c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.00 @ 2.10c.

Cold Rolled Steel Shafting—Base sizes—From store, 2¼c.

Copper—Lake ingot, 12⅛ @ 12¼c.; electrolytic, 12 @ 12⅛c.; casting, 11¾ @ 12c.

Pig Tin—In 5- and 10-ton lots, f. o. b., New York, 26 @ 26¼c.

Pig Lead—4.10 @ 4.12½c. in 50-ton lots.

Spelter—4.35 @ 4⅜c. for prompt shipment from West, New York delivery.

Antimony—Cookson's, 10 @ 10½c., according to quantity upward from one cask; Hallett's, 8 @ 8⅜c.; U. S., 8⅛ @ 8½c.; various brands, 7¾ @ 8c.

Lard Oil—Prime City, 80 @ 81c., according to brand and quantity.

Manufacturers.

The Lowville (N. Y.) Iron Works have been burned.

J. Pope Gholston will erect an oil mill at Comer, Ga.

The La Crosse (Wis.) Plow Company is to build a plant this season.

The Foster Machine Company, Westfield, Mass., is to build an addition.

A new factory will be built for the Consolidated Pump Company, Toledo, O.

A factory building is being erected by the Cleveland (O.) Crane & Car Company.

The plating plant of S. Cheney & Son, founders, Syracuse, N. Y., is to be enlarged.

An addition is being built to the Taylor Iron & Steel Works at High Bridge, N. J.

A new building is to be erected for the Morgan Spring Company, Worcester, Mass.

The Globe Wire Cloth Company, of Harrison, N. J., is erecting an addition to its plant.

The Citizens' Electric Company, St. Louis, Mo., may build a plant at the foot of Biddle street.

J. George Leyner, machinist, Denver, Colo., has taken out a building permit for a small factory.

M. W. Carr & Co., manufacturing jewelers, West Somerville, Mass., are building a new factory.

A new factory for the Independent Whip Company, Westfield, Mass., is to be erected at once.

The A. L. Blackmer Company, glass cutter, New Bedford, Mass., will make an addition to its plant.

The Uniform Steel Company, Newark, N. J., is about to equip an up-to-date plant at Rahway, N. J.

The Green Manufacturing Company, maker of lawn sweepers, Springfield, O., will build a new shop.

The American Wood Working Machine Company will enlarge its Hoyt factory at Aurora, Ill.

The Morrill Knitting Company, Woonsocket, R. I., is contemplating the erection of an addition.

The Forsyth Pattern Works, Youngstown, O., have bought some large buildings and will erect others.

The Seaman-Sleeth Company, Pittsburgh, Pa., has taken out permits for a boiler-house and foundry.

The American Bridge Company is said to be planning to enlarge its works at Minneapolis, Minn.

The Standard Foundry Company, Worcester, Mass., has taken out a permit for a building, 50x60 feet.

The contract has been awarded to build the plant for the Stroudsburg (Pa.) Engine Works Company.

The Eleanor Iron & Steel Company, rolling mill, in North Irwin, Pa., is figuring on enlarging the plant.

Work is in progress on the foundation to the addition to the Crane & Co. Pioneer paper mill, Dalton, Mass.

The United States Wind Engine & Pump Company, Batavia, Ill., has broken ground for a new foundry.

It is reported from Waycross, Ga., that the Atlantic & Birmingham Railroad Company will build car shops.

An addition is being made to the plant of the Pottstown Manufacturing Company, planing mills, Pottstown, Pa.

Thos. Forman & Co. will build at Woodmere, Mich., a new hardwood plant with boiler-house, dry kilns, etc.

Factory buildings, with a 40x60-foot engine-room, will be erected for the H. D. Beach Company, Clarksville, Tenn.

Geneva, N. Y., is anxious to secure for that town the car shops of the Rochester & Eastern Rapid Railroad Company.

The H. B. Smith Company, steam-heating appliances, Westfield, Mass., will make important additions this season.

W. C. Downey & Co., manufacturers of steel bale ties, Springfield, O., will erect a factory, 85x95 feet, two stories.

Plans and specifications have been made for an addition to the plant of the Pratt Chuck Company, Frankfort, N. Y.

Plans are being made for an addition to the plant of Thos. E. Gleeson, manufacturer of wire cloth, East Newark, N. J.

The Williams Tool Company, manufacturer of machinery, Erie, Pa., has been granted a permit for a $5,000 factory building.

The Aldrich Manufacturing Company, brass and copper goods, Buffalo, N. Y., has received a permit to erect a four-story building.

The address of the American Machine & Foundry Company, formerly Hanover, Pa., is now 346 Carroll street, Brooklyn, N. Y.

A four-story factory is to be built in Jamestown, N. Y., this year by the Bailey-Jones Company, which manufactures furniture.

The Bigelow Carpet Company, Clinton, Mass., will build a new power-house, which will furnish current for lighting purposes.

The Root Glass Company, Terre Haute, Ind., manufacturer of bottles, will put up another building as large as the present one.

Plans have been filed for an addition to the factory of the Emil Wahl Manufacturing Company, bone buttons, etc., Philadelphia.

Plans are in preparation for new shops of the Los Angeles (Cal.) & Redondo Railway Company. They will be about 120x140 feet.

Alterations will be made to the Union Traction Company's machine shop on Eighth street and Susquehanna avenue, Philadelphia.

Preparations are being made for $75,000 to $100,000 worth of improvements on the Southern Engine & Boiler Works, Jackson, Tenn.

A building permit has been taken out by the Jones National Fence Company, Cleveland, O., for the erection of a two-story factory.

The Rochester (N. Y.) Die Shaper Company has sent us a 4x6-inch pamphlet briefly describing and illustrating its vertical die shaper.

The National Knitting Works, Milwaukee, Wis., will erect an addition to be used for an engine and boiler house and the manufacture of goods.

It is rumored that the Louisville & Nashville Railroad will erect a car-building plant in Pensacola, Fla., at an estimated cost of $500,000.

The new plant which the Pittsburgh Reduction Company will build near East St. Louis, Ill., will be for the manufacture of aluminum wire.

The Fort Stanwix Canning Company will erect a large canning factory at Oswego Falls, N. Y. There will be an engine and boiler room, 40x50 feet.

The Progressive Oil & Fertilizer Company has just been organized, and has closed a deal for land at Brookhaven, Miss., on which to erect an oil mill.

The Coulter & McKenzie Machine Company, Bridgeport, Conn., is about to erect a foundry building, 100x56 feet, with an addition of 25x20 feet.

Citizens of Santa Fe, N. M., are raising money to buy terminal ground and a site for shops, roundhouses and offices of the Santa Fe Central Railway.

An addition will be built to the factory of the Bemis Omaha Bag Company, Omaha, Neb., connected with the Bemis Bro. Bag Company, St. Louis, Mo.

The Battle Creek (Mich.) Iron Works Company, Ltd., had plans made for a group of buildings, to include foundry, machine shops, etc., to cover 1½ acres.

Spartanburg, S. C., is to have another cotton mill. Mayor A. B. Calvert is at the head of the movement and a number of Northern capitalists are interested.

The Osborne & Stephenson Manufacturing Company, Plainville, Conn., electrical and clock work, will erect a new factory building, two stories high, 45x70 feet.

The Union Metallic Cartridge Company, Bridgeport, Conn., has taken out a permit to build a new factory, machine shop and storage room in Barnum avenue.

A plant to furnish power for the entire line will be erected by the Elizabeth, Plainfield & Central Jersey Railway Company at Cranford, N. J., in the near future.

It is rumored that car shops costing in the neighborhood of $800,000 are about to be built by the Delaware, Lackawanna & Western Railroad at Scranton, Pa.

The Tallapoosa (Ga.) Cotton Mill Company has applied for charter, capitalization $125,000, to build mill; J. C. Tumlin, J. T. Tuggle and others incorporators.

The Lake Erie Asphalt Block Company, Pittsburgh, Pa., is building a new machine and blacksmith shop, 30x60 feet, two stories high, at the East Side, Toledo, O.

Ground has been broken for a new stone-cutting plant for Frederick Andres & Co., Milwaukee, Wis. The plant will contain modern machinery and equipment.

The Winchester Repeating Arms Company, New Haven, Conn., has awarded the contract for the construction of a power-house, 34x60 feet, and a casting shop, 54x89 feet.

A building permit has been taken out by the Milwaukee (Wis.) Steel Casting Company

for the reconstruction of its works which were destroyed by fire a few weeks ago.

A rolling mill concern which N. D. Doxey and E. E. Buchanan are pushing forward proposes to build at Elmira, N. Y. Part of the machinery has already been purchased.

The Standard Paint Company, 100 William street, New York city, has bought land in Bound Brook, N. J., where it has a plant, and will, it is said, erect a new factory.

The Brunswick Lumber Company, branch of the Camp Manufacturing Company, of Franklin, Va., is building a band sawmill plant near DeWitt, on the Seaboard Air Line.

Messrs. Stokes and Chapman, of Valdosta, Ga., and Messrs. Huber and McEachen, from Bainbridge, Ga., were recently at Williston, Fla., looking for a location to erect a sawmill.

There is promise of a new thread factory to be built on Calnan avenue, Westfield, Mass., by a company in which E. L. Smith, formerly with the W. Warren thread works, is interested.

R. G. Wagner and A. F. Postel, of the Wisconsin Sugar Company, propose to build a beet sugar factory in Beaver Dam, provided that 4,000 acres of sugar beets be raised in that vicinity.

William W. Lawrence, president of W. W. Lawrence & Co., Inc., paint manufacturers, Pittsburgh, Pa., is having plans prepared for an eight-story paint and varnish factory, to cost $150,000.

The Canadian Pacific has undertaken some extensive grain elevator and coal dock construction work at Fort William, Ont. The machinery alone for handling the coal will cost $300,000.

The Boston (Mass.) Steel & Iron Company, whose plant is at Glenwood, Mass., has increased its capital stock from $100,000 to $1,000,000, and the business of the concern will be extended.

The Modes-Turner Glass Company, manufacturer of bottles, Cicero, Ind., is about to erect at Terre Haute, where it has works, a new furnace building, engine-room, machine shop, boiler-house, etc.

The Racine (Wis.) Hardware Company has brought out a pamphlet containing illustrations of "Racine" automatic cut-off engines connected to generators of different manufacture. It is 6x9 inches in size.

Architect and Engineer William C. Furber, of Philadelphia, Pa., is preparing plans for a manufacturing plant to be built at Wilmington, Del., to cost about $30,000. It will have a boiler-house, 30x50 feet.

The surveyors for the Chicago Great Western have been at Clarion, Ia., laying out the grounds for the roundhouse, machine repair shop, etc. It is said that the main machine shop will be 120x400 feet.

A concern embracing Philadelphia and Pittsburgh capital is looking for a 2,000-acre site for a plant on Grand Island, at Buffalo, N. Y., and it is rumored to be a branch of the United States Steel Corporation.

Chas. A. Sims & Co., railroad masonry contractors, have purchased the stone on land about two miles west of Curwensville, Pa. They contemplate putting in a lot of machinery and opening up a stone quarry.

George Groom, Samuel Drinkwater and Gus Bosley, of South Williamsport, Pa., have formed a partnership with the intention of building a brick plant at Oak Grove, to have a capacity of about 80,000 bricks daily.

The Southern Electric Telephone Company has been incorporated under the laws of West Virginia, with a capital stock of $50,000. A plant will be erected at Memphis, Tenn., for the manufacture of telephone instruments.

The American Roller Bearing Company, 32 Binford street, Boston, Mass., publishes a little priced catalog (3⅛x5¾ inches) of roller bearings for general use, of automobile hubs and wheels and of shafting hangers.

The Mossberg Wrench Company, Attleboro, Mass., is said to have decided to build a new factory, perhaps in Pawtucket, R. I. The new plant would require at least 200 hands, instead of seventy-five as at present.

It is reported from Crescent City, Fla., that Dean Bros. Lumber Company has been organized for erection of sawmills to develop timber lands recently purchased by G. W. Dean. Present address is understood to be Espanola, Fla.

Ground has been broken by the Standard Steel Works, at Bethlehem, Pa., for two buildings, 90x300 feet, to be used as foundry and casting room. Locomotive cylinders will be manufactured for the Baldwin works, it is reported.

The National Construction Company, of Detroit, Mich., has entered into agreement with the Mt. Pleasant Sugar Company to erect a 600-ton beet sugar factory in Mt. Pleasant, Mich., to be completed by October 1, 1903.

Sibley & Ware, South Bend, Ind., have sent us a small pamphlet (3½x6 inches, a standard size) showing a number of power drills. Upright drill presses are shown, of 20, 24, 26 and 28 inches, having some variety in features.

The National Enameling & Stamping Company is erecting a foundry department as an addition to its rolling mill, at Granite City, Ill. It will be used for casting steel rolls and in the manufacture of machines for the rolling mill.

Two powder mills at Keokuk, Ind., of the E. I. Du Pont (De Nemours) Company, Wilmington, Del., which were destroyed by an explosion, will be rebuilt. They will be electric mills and be used for the manufacture of blasting powder.

The G. H. Hammond Company has purchased the site for the big packing plant that it is to build in Chicago. The new packing houses will be equipped with the latest and best machinery. The new buildings will cost close to $2,500,00.

H. C. Doman, proprietor of the Union Iron Works, Oshkosh, Wis., will build a plant three times the capacity of the present factory. It will be 200x50 feet. Mr. Doman is the inventor of gasoline engines and manufactures gasoline launches.

The Lehigh Foundry Company, of Fullerton, Pa., has closed a contract with Snare & Triest, of New York, for the erection of new foundry buildings, 560 feet long, 45 feet wide and 37 feet clear, with an extension of 280 feet long, 30 feet wide and 17 feet clear.

John E. Beird, secretary of the Ballard (Wash.) Chamber of Commerce, is in receipt of a communication from the Aetna Manufacturing Company regarding a plant which they propose to establish there to make locomotives, trucks and other logging railway equipment.

Guy G. Major, of New York, is interested in shaping the affairs of the new Union Lead & Oil Company. This is capitalized at $17,000,000, and plans to build three lead corroding plants—one near New York city, another at St. Louis, Mo., and the third in Toledo, O.

The Southern Illinois Engine & Boiler Company, Buffalo, N. Y., has been in operation since January 1. It already employs 300 men. The works, as they stand, cost about $200,000. This spring the company proposes to build a rolling mill employing an additional 500 men.

A machine for sealing letters has been patented by Harry Harte, of Rochester, N. Y., who proposes to establish a plant to manufacture the machines in Rochester. A company is now in formation, and Secretary Ives, of the Chamber of Commerce, invites attention to the enterprise.

The plant of the United States Tube Company has been organized at Murphysboro, Ill., with Martin Schauerte, Wm. Schauerte, Wm. Michaels, Thos. Burton and Ed Bencini as stockholders. The company has purchased a factory, and the buildings will be remodeled and new ones erected.

The Fischer Foundry & Machine Company, of Pittsburgh, Pa., will erect a plant between Connellsville and White Rock for the manufacture of automatic steam engines. A site of 450 acres has been secured and several large buildings will be erected. The total cost will be about $400,000.

The Clark Automatic Telephone Switch-Board Company, Providence, R. I., has recently closed contract with the Maine Insane Hospital at Augusta, Me., for sixty stations and with the De Beers Explosive Works, Somerset West, Cape Colony, South Africa, for forty-eight stations.

Arnold & Howard, of Pittsburgh, Pa., are taking formal possession of the Catchpole Boiler & Machine Works, Geneva, N. Y. They will enlarge the plant. Besides the manufacture of the Catchpole boiler, they will put on the market a patent temperature controller, water-level controller, radiator, etc.

M. C. D. Borden, of New York city, has been in Fall River, Mass., preparing for the construction of a new mill close to the four now in operation (Fall River Iron Works Company). It will be the size of No. 3, and will have 62,000 spindles, employing 900 persons and turning out 15,000 pieces weekly.

The Sharp Manufacturing Company is about to be organized at Albert Lea, Minn., to manufacture windmills, horse-powers, tanks, silos and, a little later, gasoline engines. J. G. and J. E. Saarp are interested. It is an outgrowth of a business already in operation. A 24x50-foot foundry will be added to the present buildings.

The Jeanesville (Pa.) Iron Works Company has commissioned Hales & Ballinger, of Philadelphia, Pa., to make plans for additions to its pump works. The additions will include a new foundry building, extension to their machine shop, new three-story pattern shop, new three-story office building and minor improvements.

Plans have been filed for the Great Northern shops at St. Paul, Minn. The arrangement contemplates five buildings. The principal one will be the machine shop, 150x600 feet. The boiler shop will be 235x425, and will be arranged to accommodate traveling cranes and hoisting machinery. The power house will be 30x160 feet.

Some time since the J. & J. Rogers Company stockholders, Ausable Forks, N. Y., voted to build a new paper mill. It now develops that the plan is to build a $300,000 plant. The building will be 430x150 feet. It is planned to make use of all the waterfalls controlled by the company—in other words, to arrange it so as to "compound" their power.

The Wireton Heating Company, of Blue Island, Ill., manufacturer of heating apparatus and foundry, has completed arrangements for the location of its works at Chicago Heights. These will include: Foundry, 80x150 feet; machine and tin shop, 50x250, two stories high; pattern shop, 50x80, two stories high; boiler and engine-house, 50x80, and warehouse, 100x200.

The Juniata Tube Company, capitalized at

$800,000, will erect a tube mill at a cost of $200,000, to employ about 300 men. The officers include E. H. Weeks, Philadelphia, president; J. I. Quigley, Lewistown, Pa., vice-president; H. J. Fornot, Lewistown, secretary and treasurer. The main office will be in Lewistown, the factory at Burnham and the foreign office in Philadelphia.

The Davis-Walker-Cooper Company, composed of Evan J. Davis, Charles Walker, James Cooper and several others, has been incorporated, with a capital stock of $50,000, to do a general line of machinery building for rolling mills and steel plants. The company is buying machinery for its plant, which is at Youngstown, O., and which will include a machine shop, foundry, forge shops, etc.

The Wright Taper Roller Bearing Company has bought land for a factory at Buffalo, N. Y. For some time past the bearings have been manufactured in Niagara Falls, N. Y. When the Buffalo shop is in operation 300 men will be employed. The officers of the company include: President, Lewis J. Bennett; vice-president, James P. Wood; secretary, Albert G. Thorne; treasurer, Eugene A. Georger, all of Buffalo.

The Satterfield Ginning Company, Ltd., New Iberia, La., has been formed with the following officers: W. E. Satterfield, cashier of the People's National Bank, president; G. H. Laughlin, vice-president; I. N. Satterfield, secretary and treasurer. This company will operate not only a gin, which will include a delinter in the city, but several like concerns throughout the parish. During the year it will also build an oil mill.

The Sharon Foundry Company has awarded the contract to the Riter-Conley Manufacturing Company for the erection of its new foundry and ingot mold plant at Wheatland, near Sharon, Pa. The main building will be 450x130 feet. The company has just been granted a State charter, the incorporators being Joseph Riddell, W. W. Shilling, Simon Perkins, E. A. Wheeler, H. P. Forker, N. McConnell, V. M. Delamater and E. H. Williams, all of Sharon; Robert Hitchcock and Robert Bentley, of Youngstown, O., and Alexander Laughlin, of Pittsburgh.

The Crompton & Knowles Loom Works, of Worcester, Mass., have purchased the entire loom business of the M. A. Furbush & Son Machine Company, of Philadelphia and Camden, which has been carried on about half a century. Arrangements have been made by the Crompton & Knowles Loom Works for the erection of new buildings in Philadelphia for the manufacture of the looms heretofore made by the Furbush Company in Camden. These are principally for the weaving of carpets and rugs. Eventually all kinds of Crompton-Knowles looms will be made there.

Contracts have been awarded by the directors of the Pittsburgh, McKeesport & Connellsville Railway Company for erecting and equipping a large power-house at New Haven, Pa. The contract for erecting the building was let to James Stewart & Co., Pittsburgh. There will be twelve boilers of 500 horse-power each, three generators of 1,500 horse-power each, a pumping plant with a capacity of 6,000,000 gallons a day, three engines of 1,850 horse-power each, a 30-ton electric crane, and coal- and ash-hauling machinery. The total cost of the machinery will be about $325,000. Nine sub-stations are being planned.

The Duquesne Fireproofing Company has applied for a charter. The new company is composed of prominent Pittsburgh capitalists, will build a plant at West Winfield, Butler County, Pa., and will manufacture fireproof material for large buildings, sewer pipe, buff brick, etc. The capacity will be 40,000 bricks a day. Offices will be established in the Tradesmen's building, Pittsburgh. The officers are: President, F. W. McKee; vice-president, E. J. Frauenheim; secretary, J. A. Frauenheim; treasurer, W. C. Lynne, and general manager, George H. Albertson.

The Perkins Machine Company has been formed, under the laws of Maine, to succeed the press building company of the same name. The office and factory are at K and East First streets, South Boston, Mass. Col. A. A. Pope, of Boston, pioneer in the manufacture of American bicycles; E. W. Pope, past treasurer of the Pope Manufacturing Company; Bertram D. Perkins, Fred and Charles A. Perkins are the directors. Stock is not to be placed on the market, as it is a close corporation. It is to erect two buildings, 100x60 feet; another machine shop and foundry, equipped with the best tools. The old company was a Massachusetts corporation, but having worked day and night four years out of six, it was obliged to form the new company in order to take better care of customers and agencies. The new company will continue to manufacture the Perkins power presses, dies for sheet metal, etc., and will take up more with the tin can manufacturing.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Stamping dies. Emmons Collins, Chicago.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Partner in gasoline engine business; some capital required. Address Box 329, AMERICAN MACHINIST.

Special tools, models, fine light mach'y and foundry work wanted. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, cut light gears, cams and duplicate small machine parts, in quantities.

We solicit contracts for machine work or forging; first-class and modern equipment; estimates given. Erie Basin Iron Works, 54 Beard st., Brooklyn, N. Y.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

Mechanical engineer, 20 years' successful shop and office experience, well-located Philadelphia office, wishes paying specialty; commission or salary. M. E., care AM. MACH.

Wanted—Contract work for 34 in. x 8 ft. planer, 32 in. lathe raised to 48 in., 20 ft. between centers; also full line of smaller tools; also first-class foundry. Box 298, AM. MACH.

Wanted—Working drawings or blueprints of gate valves, with and without yokes, from 3 to 24 in.; also of two-, three- and four-way hydrants, light patterns, latest designs. Price and particulars to Box 314, AMER. MACH.

Purchaser for small manufacturing plant in Madison, Wis.: lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Wanted—Practical, working partner in established, profitable and rapidly growing metal specialty business; $1,000 to $5,000 required, according to interest desired; full information and references required and furnished. Address Box 331, AMER. MACH.

To makers of plain and universal milling machines, brass working machinery, boring and turning mills and bolt-cutting machines—An English firm of machinery importers desires to communicate with above, with a view of arranging exclusive agency for Great Britain. Address Box 335, AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Position as mechanical draftsman; A1 references. Box 328, AMER. MACHINIST.

A position as superintendent or general foreman. Box 297, AMERICAN MACHINIST.

Draftsman, technical graduate, desires change; gas compressor or engine work preferred. Box 325, AMERICAN MACHINIST.

Experienced forger and tool-dresser wants position; one who is a first-class temperer on dies, etc. Address Box 334, AMER. MACH.

Junior mechanical draftsman, few months' experience, shop experience, desires position; salary no object. F. V. C., care AM. MACH.

First-class machinist and toolmaker, with 7 years' experience in Sweden and Germany, age 22, desires position. F. F., care AM. M.

Draftsman, experienced in automatic and special machinery and steam engines; shop experience; references. Address Box 319, A. M.

I want a position in the machine shop; well up in heavy tools and workshop practice; 8 years in shop and 1 in drafting room. Box 324, AMERICAN MACHINIST.

Wanted—Position as superintendent, manufacturing bedstead mounts and trimmings or general brass goods. Address "Bedsteads," care AMERICAN MACHINIST.

Engineer, experienced in the design, construction and erection of mechanical stokers, furnaces and boilers, desires to change. Box 320, AMERICAN MACHINIST.

Would like to engage with firm wanting to build a strictly high-grade gas engine; can guarantee success from the start. Address Box 316, AMERICAN MACHINIST.

A good draftsman, with experience on tools and wood-working machinery and about 3 years' shop practice, desires position. Address G——m, care AMERICAN MACHINIST.

Responsible position wanted by expert on automatic machinery; draftsman, engineer, superintendent; 10 years' experience; age 31; technical graduate. Box 307, AM. MACH.

Man with technical education, shop experience, inventive ability, machine designer, wants partnership, small shop manufacturing novelties or gas engines. Box 322, AM. M.

Superintendent of printing press works, expert draftsman and mechanical engineer, desiring change, solicits correspondence with reliable firms; excellent references. Address Box 247, AMERICAN MACHINIST.

Superintendent, general foreman, with office experience, desires change; capable of handling and organizing complete shops; experience excavating, conveying, mining; steam and gas engines. Box 263, AMER. MACHINIST.

All-around machinist and toolmaker, first-class mechanic, technical education, good executive, position as foreman or superintendent; only firms needing a good man need answer. Box 286, AMERICAN MACHINIST.

Position wanted as engineer and master mechanic with large industrial or mining company, or as erecting engineer for large plants; 20 years' experience; good education; references. Address Box 317, AMER. MACH.

Position desired by technical graduate, international training, age 32; 10 years' experience devising and superintending construction of machinery and the manufacture of small parts on interchangeable lines; at present in Germany; good handler of help. Address Box 332, AMERICAN MACHINIST.

Mechanical engineer and draftsman wishes to make change; Eastern States preferred; 18 years' experience as foreman, master mechanic and superintendent, manufacturing small interchangeable machinery, fine steel instruments and sheet-metal goods. Address Box 299, AMERICAN MACHINIST.

Mechanical engineer with technical education and practical experience, at present editor of an engineering magazine, would like to hear from responsible parties who may desire his services; can furnish best of references in regard to character, ability, past experience, etc.; at liberty as soon as desirable opening is presented. Address Box 330, A. M.

An experienced mechanical manager and superintendent would like to correspond with parties in or near New York city who will soon be in want of a first-class man with plenty of push, business tact, executive ability, any amount of inventive genius and practical experience; if you are starting a new concern or wish to revise an old one, I can serve you in an up-to-date manner; highest testimonials as to ability, etc. Box 318, A. M.

Mechanical engineer, designer and inventor, for past 3 years on expert hydraulic work developing important invention, desires position with concern capable of building same as a specialty; practical machinist and Lehigh graduate; has been assistant master mechanic in large steel works and mechanical engineer for manufacturing company, in charge of design and erection of all buildings and machinery in six plants; age 34; married; first-class references from all employers; salary $2,500 or more. Address Box 321, AMER. MACH.

Help Wanted.

Wanted—Machinists, lathe hands; steady position. The Michigan Brass & Iron Works, Detroit, Mich.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

Foreman wanted for small foundry doing general casting and engine work. "Georgia," care AMERICAN MACHINIST.

Wanted—A draftsman qualified for detail work on Corliss engines. Address Allis-Chalmers Co., Scranton, Pa.

Wanted—Die Sinker; competent man on work similar to steel stamps. Durbrow & Hearne Mfg. Co., 8 Wooster st.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

Wanted—Patternmaker, wood only, mostly small work; permanent position; state wages expected. "Worcester County," care AM. M.

Machinists wanted to act as shop agents and sell small tools where they work. Address E. H. Randall, 235 Woodland ave., Springfield, Ohio.

Wanted—A1 draftsmen experienced in steam hammer design; give full particulars as to ability, age and salary; good opening. Address Box 310, AMERICAN MACHINIST.

Patternmaker wanted; first-class man on small and medium-sized work; steady position; good wages; open shop in large Western city. Address Box 333, AMER. MACH.

Wanted—A good detail draftsman with experience in machine tool work; must be quick and accurate; state age, experience and salary. Address Box 313, AMER. MACHINIST.

Wanted—Foundry foreman for Middle West, in healthy locality, in foundry employing 75 men; applications wanted from first-class men only. Address Box 288, AMER. MACHINIST.

Wanted—Several A1 mechanical or electrical draftsmen; send references and state salary expected. Apply to Engineer, Drafting Dept., General Electric Co., Schenectady, N. Y.

Wanted—Machine designer for position in large Western city; experience in sheet metal working machinery desirable, but not essential; experienced men only need apply; state full particulars. Box 323, AMER. MACH.

Wanted—Foreman for a large modern brass foundry; must understand the mixing of metals, running machines and handling men; state age, experience, wages expected. Address "Electric," care AMER. MACHINIST.

Wanted—One or two first-class mechanical draftsmen, experienced in general machine design or in the design of coal-mining machinery; state experience, age and salary expected. Address "M.," care AMER. MACH.

Toolmakers Wanted.—Three first-class men on fine accurate watch lathe work in Greater New York; good pay and steady employment for right men; state wages, expected, experience, former employers, etc. Box 327, AM. M.

Machinists Wanted.—We need 30 lathe hands and 20 planer hands for night gang on heavy machine tool work; to work 12 hours per night, five nights per week; good pay to good men. Apply to The Pond Machine Tool Co., Plainfield, N. J.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Draftsman experienced in designing dynamos, motors, switchboards and other electrical machinery for direct-current railway and power systems; give age, experience, education and salary expected. Address R. K., care AMERICAN MACHINIST.

Engineers, firemen, machinists and electricians, send for 40-page pamphlet containing questions asked by Examining Board of Engineers to obtain engineer's license. Address Geo. A. Zeller, Publisher, Room 500, 18 S. 4th st., St. Louis, Mo.

Bradley Manufacturing Company, Pittsburgh, Pa., American builders of the Willans central valve engine, desire a general superintendent for their new works; a man thoroughly acquainted with accurate work is desired. Box 292, AMERICAN MACHINIST.

Wanted—Draftsman for light, automatic machinery and small tools; one accustomed to some designing and planning details from suggestions; state age, experience and wages expected; factory located in Worcester County, Mass. Box 314, AMERICAN MACHINIST.

Wanted—Competent manager for old-established machine tool works (incorporated) who could take some stock; parties only furnishing first-class references given opportunity to investigate; give experience and amount could invest. Box 312, AMER. MACHINIST.

Wanted.—The services of an experienced mechanical draftsman are desired for a position with manufacturing concern located in the country; applicants will please state previous experience, salary expected and furnish references. Box 293, AMERICAN MACHINIST.

Wanted—Thoroughly competent foreman on machine tool building, experienced in building pipe threading machinery, familiar with methods of producing duplicate parts on turret lathes; give age, experience, salary expected and references. Box 237, AMER. MACH.

Draftsman, of first-class skill, wanted in manufacture of highest grade fine instruments; unusually attractive position for right man; satisfactory compensation and association with experts. Address, stating age, experience and desired salary. "Electrical, Massachusetts," care AMER. MACHINIST.

Wanted—By a large works in the East, whose specialty is machine tools, skilled machinists to operate lathes, planers, boring mills, milling machines, chucking machines, Landis grinders, etc, etc.; also toolmakers and fitters; good wages and steady work to good men; every applicant will receive a reply whether employed or not. Box 326, AM. M.

We are equipping our new shops at Trenton with an increased number of machine tools and require skilled machinists to operate them; we also want fitters, toolmakers, erectors, etc.; our specialties are steam turbines and machine tools; applications are invited from first-class workmen only, to whom we will give steady employment and good wages. De Laval Steam Turbine Co., Trenton, N. J.

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Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Anti-Friction Metal

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Balls, Steel

Automobile & Cycle Parts Co., Cleveland, O.
Grant Tool Works, Franklin, Pa.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Oilless

Arguto Oilless Bearings Co., Philadelphia, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Sure Grip Mfg. Co., Phila., Pa.

Belt Lacing Machines

Diamond Drill & Mach. Co., Birdsboro, Pa.

Bending Machines, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Reade Mchry. Co., Cleveland, O.

Bending Tools, Hand

Estep & Dolan, Sandwich, Ill.

Blocks and Tackles

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Blowers

Amer. Blower Co., Detroit, Mich.
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.

Blue Printing Machines

Pittsburgh Blue Print Co., Pittsburgh, Pa.

Blue Print Wringers

Pittsburgh Blue Print Co., Pittsburgh, Pa.

Boilers

Chandler & Taylor Co., Indianapolis, Ind.
Struthers, Wells & Co., Warren, Pa.

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Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Howard Iron Works, Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Francis Reed Co., Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Books, Mechanical

Baird & Co., Henry Carey, Philadelphia, Pa.
The Draftsman, Cleveland, O.
Henley & Co., N. W., New York.
Spon & Chamberlain, New York.
Wakeman, W. H., New Haven, Ct.

Boring and Turning Mills

Am. Tool Wks. Co., Cincinnati, O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
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Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Keystone Mach. Tool Wks., Philadelphia, Pa.
Newton Mch. Tool Wks., Philadelphia, Pa.
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Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
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Brazing and Fluxing Material

American Ferrofix Co., New York.

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Smith, E. G., Columbia, Pa.

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Castings, Aluminum

McKenna & Bro., Jas. J., New York.

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Christensen Engineering Co., Milwaukee, Wis.
McKenna & Bro., Jas. J., New York.

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Franklin Mfg. Co., Syracuse, N. Y.

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Farrel Fdry. & Mach. Co., Ansonia, Conn.

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Acme Steel & Mall. Iron Works, Buffalo, N. Y.
Christensen Engineering Co., Milwaukee, Wis.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Uniform Steel Co., Newark, N. J.

Centers, Planer

Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
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Reed Co., F. E., Worcester, Mass.

Centering Machines

Bement, Miles & Co., New York.
Binghamton Mach. Tool Works, Binghamton, N. Y.
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Pond Mach. Tool Co., New York.

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Automobile & Cycle Parts Co., Cleveland, O.
Boston Gear Works, Boston, Mass.
Jeffrey Mfg. Co., The, Columbus, Ohio.
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Whitney Mfg. Co., Hartford, Ct.

Chemicals

American Ferrofix Co., New York.

Chucking Machines

Cleveland Mach. Screw Co., Cleveland, O.
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Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

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Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
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Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
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Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Sons Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Hardinge Bros., Chicago, Ill.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Collectors, Dust
Allington & Curtis Mfg. Co., Saginaw, Mich.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

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Countershafts
Builders' Iron Fdry., Provi., R. I.
Fulton Mach. Co., Canal Fulton, O.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Couplings, Shaft
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

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Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machines
Underwood & Co., H. B., Philadelphia, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Byram Co., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Delivouk & George, Chicago, Ill.
Perkins Mach. Co., Boston, Mass.

Drawing Tables and Boards
Alexander Mfg. Co., J. G., Grand Rapids, Mich.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
Amer. Tool Wks. Co., Cincin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Fosdick & Holloway M. T. Co., Cincinnati, O.
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Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reade Mchry Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
Am. Tool Wks. Co., Cincinnati, O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Francis Reed Co., Worcester, Mass.
Rhoades Mfg. Co., Columbus, O.
Sibley & Ware, South Bend, Ind.
Snyder, J. E., Worcester, Mass.
Washburn Shops, Worcester Mass.

Drills, Center
Pratt & Whitney Co., Hartford Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Mediren, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Elec. Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
General Elec. Co., New York.
General Incan. Arc Light Co., New York.
Triumph Electric Co., Cincin., O.
Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Abro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Works, Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.
Whiting Fdry. Equipment Co., Harvey, Ill.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.

Engines, Gas and Gasoline
Charter Gas Engine Co., Sterling, Ill.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Pierce-Crouch Engine Co., New Brighton, Pa.
Regal Gas Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.
Weber Gas & Gasoline Eng. Co., Kansas City, Mo.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Chandler-Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Heath, Chas. H., Trenton, N. J.
Rand Drill Co., New York.

Engine Stop
Consolidated Engine Stop, Co. New York.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.
Flower & Co., Walter L., St. Louis, Mo.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Clapp Mfg. Co., E. D., Auburn, N. Y.
Keystone Drop Forging Co., Philadelphia, Pa.
Wilcox Mfg. Co., D., Mechanicsburg, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Byram Co., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Pattern Works, Chicago, Ill.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Turley, H. G., St. Louis, Mo.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Farrell Fdry. & Mch. Co., Ansonia, Conn.
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Lisey-Wolf Mach. Co., Cincinnati, Ohio.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gleason Mach. Works, F., Philadelphia, Pa.
Gould & Eberhardt, Newark, N. J.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Delivouk & George, Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Anderson Tool Co., Anderson, Ind.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Anderson Tool Co., Anderson, Ind.
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincinnati, Ohio.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co. Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, Mass.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Grindstones
Cleveland Stone Co., Cleveland, O.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
Olmstead, L. H., Hasbrouck Heights, N. J.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburgh Shear Knife & Mch. Co., Pittsburgh, Pa.

Handles, Machine Tool
Norwood Bicycle Co., Cincin., O.
Schacht Mfg. Co., Cincinnati, O.

Heads, Exhaust
Burt Mfg. Co., Akron, Ohio.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Amer. Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.
Whiting Fdry. Equipment Co., Harvey, Ill.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York

Igniter, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.
Maxwell Engr. Co., Rome, N. Y.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.
Woodman Mfg. & Supply Co., R., Boston, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co. Boston, Mass.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Injectors
Lunkenheimer Co., Cincinnati, O.
Rue Mfg. Co., Philadelphia, Pa.
Sellers & Co., Wm., Phila., Pa.

Instruction Schools
See Schools, Correspondence.

Instruments, Drawing
Keuffel & Esser Co., New York.

Insurance, Boiler
Hartford Steam Boiler Insp. & Inc. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Joints, Universal
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mach. Co., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill Tool Co., Anderson, Ind.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Gen. Incan. Arc Light Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co. Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, conn.
Schwickart, Ph., Brooklyn, N. Y.

Lathe Feed
Nat'l Mach. Tool Co., Cincin., O.

Lathes
American Tool Wks. Co., Cin., O.
Auto. Mach. Co., Bridgeport, Ct.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Greaves, Klusman & Co., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Binghamton Machine Tool Works, Binghamton, N. Y.
Blanchard Mach. Co., The, Boston, Mass.
Delivouk & George, Chicago, Ill.
Hardinge Bros., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Stowell, J. A., Leominster, Mass.
Walter, E. P., Bridgeport, Conn.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crescent Instrument Works, Dubuque, Ind.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Reichhelm & Co., E. P., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Tracy, Robinson & Williams, Hartford, Conn.
Turner & Co., F. L., Orange, Mass.
Wyke & Co., J., East Boston, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., Ne wYork.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Oesterlein Mach. Co., Cincin., O.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Motors, Electric
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Electric Co., New York.
General Incan. Arc Light Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison Wis.
Robbins & Myers Co., Springfield Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co. Pittsburgh, Pa.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Metallic
U. S. Metallic Packing Co., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans and Tote Boxes
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyon Mfg. Co., Chicago, Ill.

Pans, Lathe
Lyon Mfg. Co., Chicago, Ill.
New Britain Mch. Co., New Britain, Conn.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Bevans, James W., Washington, D. C.
Cromwell, W. H., Washington, D. C.
Cullen, Orlan Clyde, Washington, D. C.
Patent Title & Guarantee Co., New York.
Stevens & Co., Milo B., Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cincinnati, O.

Patterns, Wood
Balkwill Pattern Works, Cleveland, Ohio.
Gobeille Pattern Co., Cleveland, O.
Olmstead Co., H. B., New York.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer-Eames Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven Conn.
Pond Mach. Tool Co., New York.
Sellers & Co., Wm., Phila., Pa.
Walter, E. P., Bridgeport, Conn.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Keystone Mach. Tool Wks., Philadelphia, Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Phila., Pa.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Delivouk & George, Chicago, Ill.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Profilers
Garvin Mach. Co., New York.

Pulleys
Amer. Pulley Co., Philadel., Pa.
Cresson Co., Geo. V., Philadel., Pa.
Fulton Mach. Co., Canal Fulton, Ohio.
Howard Iron Works, Buffalo, N. Y.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., Boston, Mass.
Pittsburgh Shear Knife & Mch. Co., Pittsburgh Pa.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleve., O.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Rheostats
General Incan. Arc Light Co., New York.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Roller and Ball Bearings
Amer. Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Roller Bearing & Equipment Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks., Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson & Co., J. W., Philadel., Pa.

Sand Mixing Machines
Smith Fdry. Supply Co., J. D., Cleveland, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Keystone Mach. Tool Wks., Philadelphia, Pa.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Ohio State University, Columbus, Ohio.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
Amer. Tool & Mch. Co., Boston, Mass.
Springfield Separator Co., Springfield, Vt.

Shafts, Flexible
Chicago Flexible Shaft Co., Chicago, Ill.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.

Shapers—*Continued*
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.

Shapers, Vertical Die
Rochester Die Shaper Co., Rochester, N. Y.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., Boston, Mass.
Pittsburgh Shear Knife & Mach. Co., Pittsburgh, Pa.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Springs
Cleveland Wire Spring Co., Cleveland, O.
Dunbar Bros., Bristol, Conn.

Sprocket Chains
See Driving Chains.

Squares
Turner & Co., F. L., Orange, Mass.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Machinery
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., N. Y. City.

Straightener, Screw
Towsley Mfg. Co., J. T., Cincinnati, O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M. Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., The, Cleveland, O.
Pratt & Whitney Co., Hartford, Ct.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.

Tools
See Machinists' Small Tools.

Transmission Machinery
Allston Foundry Co., Boston, Mass.
Amer. Pulley Co., Philadel., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Whiting Fdry. Equip. Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Trucks, Shop
Towsley Mfg. Co., J. T., Cincinnati, O.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.
Standard Welding Co., Cleveland, Ohio.

Turrets, Carriage
Bayldon Mach. Tool Co., Jersey City, N. J.
Fay & Scott, Dexter, Me.

Turret Machines
Amer. Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Valves
See Steam Fittings.

Vises, Drill
Fulton Mach. Co., Canal Fulton, Ohio.
Hopkinson Mach. Works, Springfield, Mass.

Vises, Metal Workers'
Hammacher Schlemmer & Co., New York.
Howard Iron Works, Buffalo, N. Y.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Vanderbeek Tool Wks., Hartford, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Washer and Tester, Boiler
Rue Mfg. Co., Philadelphia, Pa.

Welding, Electric
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

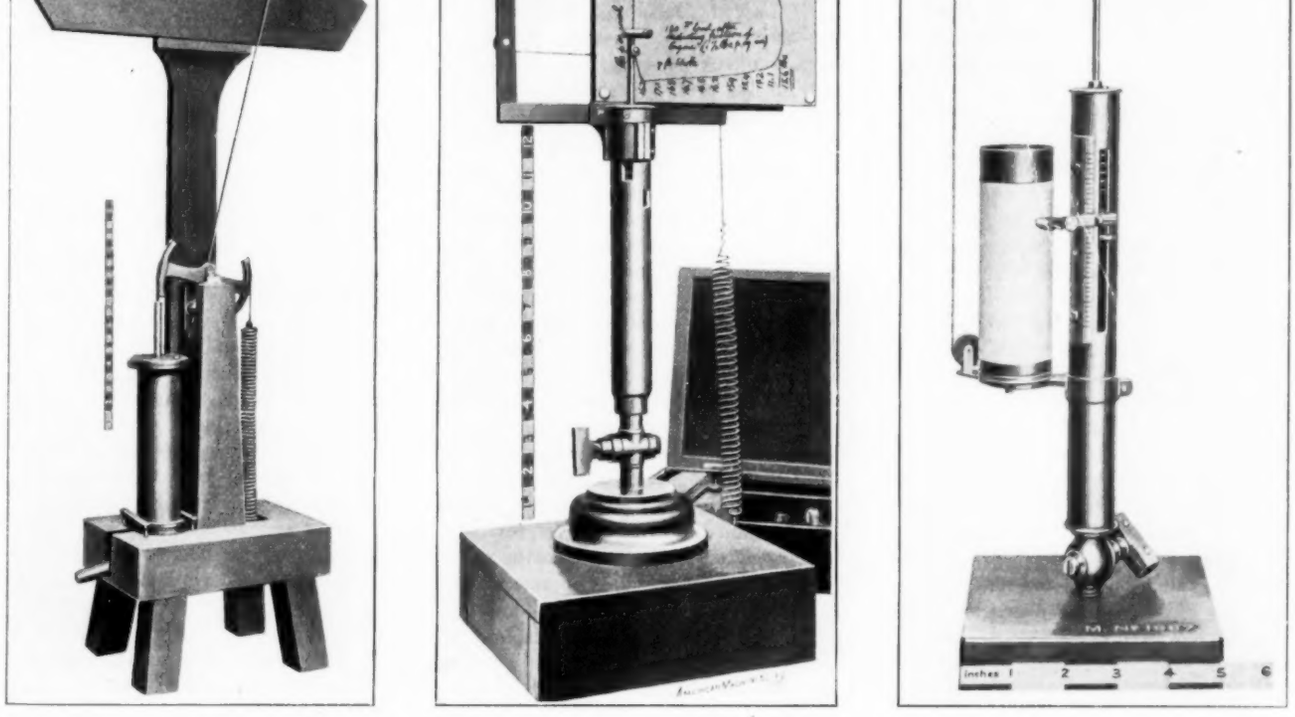
Old Steam Engine Indicators.

We are indebted to *The Engineer,* of London, for the accompanying illustrations and descriptions of some old steam engine indicators which are among the collections of antiquities at the South Kensington Museum. As is well known, the indicator was invented by James Watt, who, however, kept its existence secret for several years, and the exact date of the invention is hence not known. As invented by Watt, the instrument had no paper or pencil, but was read by watching the movement of a long, light pointer atached to the piston. Following is a description of this instrument in Watt's own words, which, with all that follows, we take from our contemporary:

"The following instrument, called the indicator, is found to answer the end sufficiently. A cylinder about 1 inch diameter and 6 inches long, exceedingly truly bored, has a solid piston accurately fitted to it, so as to slide easy by the help of some oil; the stem of the piston is guided in the direction of the axis of the cylinder, so that it may not be subject to jam or cause friction in any part of its motion. The bottom of this cylinder has a cock and small pipe joined to it, which, having a conical end, may be inserted in a hole drilled in the cylinder of the engine near one of the ends, so that by opening the small cock a communication may be effected between the inside of the steam engine cylinder and the indicator.

"The cylinder of the indicator is fastened upon a wooden or metal frame, more than twice its own length; one end of a spiral steel spring, like that of a steel spring yard, is attached to the upper part of the frame, and the other end of the spring is attached to the upper end of the piston rod of the indicator. The spring is made of such a strength that when the cylinder of the indicator is perfectly exhausted the pressure of the atmosphere may force its piston down within an inch of its bottom. An index being fixed to the top of its piston rod, the point where it stands, when quite exhausted, is marked from an observation of a barometer communicating with the same exhausted vessel, and the scale divided accordingly."

We have here the first conception of a steam engine indicator, but this earliest instrument was simply a pressure, or rather a vacuum gage, and this is probably the only part actually invented by Watt himself. From his account it appears to have been similar to the illustration, Fig. 1, and the patent was probably taken out about 1782. The model from which this photograph has been kindly furnished to the writer is now in the Victoria and Albert Museum, South Kensington, and is undoubtedly the earliest extant form of an indicator. In this interesting old instrument, which bears no date, there are no means of taking a diagram, as is now usually done. It consists of a small vertical cylinder, one square inch in area and about 6 inches long, with piston and rod, stroke 3 inches. The piston rod is connected to a light chain fastened to one end of a small rocking beam to the other end of which another chain connected to a strong helical spring is attached. The cylinder is open at the top and closed at the bottom, through which communication by means of a cock and pipe is opened with the working steam in the engine cylinder. To the center of the beam a long light pointer is attached, and the pressure of the steam admitted into the small cylinder from the engine causes the pointer to move to and fro along a scale at the top. This curious old instrument is called a "vacuum indicator" in the Museum catalog. The pressures of steam being in those days very low—not more than about 3 pounds above the atmosphere—it served more frequently to mark the vacuum, which it probably indicated with tolerable accuracy.



OLD STEAM ENGINE INDICATORS AT THE SOUTH KENSINGTON MUSEUM.

So useful an apparatus could not fail to be developed, to meet the ever-growing requirements of the steam engine. It is to Mr. Southern, a mechanic in Messrs. Boulton & Watt's factory at Soho, that the addition of the pencil and moving paper for recording the pressures in the cylinder is usually ascribed. As soon as Watt had applied the principle of expansion in the cylinder and cut off the steam at a given point in the stroke, it became desirable to know how the pressure was maintained throughout the stroke, and the work done by the steam while expanding—in other words, to obtain a diagram of pressures. The addition of the recording pencil and paper, the abolition of the rocking beam, and the transference of the spring to the top of the indicator piston itself,

gave in all essentials the steam engine indicator as we now have it, but only for very slow speeds—say, 10 to 20 strokes per minute.

Fig. 2, which is also from a photograph kindly supplied by the South Kensington authorities, shows the indicator as used later by Watt himself and all his people, with the pencil attached to the indicator piston rod. The history of this little instrument is interesting. After being worked by Watt, it came into the hands of Mr. Bennett, one of the employees at the Soho factory. He afterwards went to Manchester, joined Mr. Wrenn, became Messrs. Boulton & Watt's agent there, and indicated their engines. The instrument was shown to Professor Cowper, who took diagrams with it in 1840, and finally came into the possession of his son, Mr. Ed. A. Cowper, by whom it was presented or lent to the Victoria and Albert Museum.

The indicator consists of a small vertical brass cylinder one square inch in area and 1-13 inch diameter, carrying a piston provided with a helical spring, and a piston rod to which a pencil is attached. The spring is formed of 27.5 turns of wire 0.065 inch diameter, the mean diameter of the spring being 0.98 inch and the scale 1 inch = 1 pound per square inch. The ends of the spring are soldered to nuts, by which they can be screwed on to the indicator piston and cover. The equivalent weight of the reciprocating parts—that is, of the masses having the same weight as the piston, together with one-third the weight of the helical portion of the spring—is 0.27 pound, and the total weight of the indicator is 4.65 pounds. Below the indicator cylinder there is a cock and pipe, to admit the steam from the motor cylinder. The pressure of the steam pushes up the indicator piston against the counter pressure of the spring, and the hight to which the piston rod and pencil are raised gives the varying pressures of steam in the motor cylinder. To supply a record of these pressures a light flat frame was fixed above the indicator cylinder, at right angles to it, carrying a panel or board sliding in grooves in the metal frame. A string connected to the panel was attached to some part of the parallel motion of the engine, and thus the panel was drawn in a horizontal direction at each motor stroke, the return motion being effected, as here shown, by a weight and string passed over a pulley. The probable date of these two Watt indicators is before 1800.

The diagram traced on the board in Fig. 2 is one taken by Professor Cowper in 1840 with this indicator from a 60 horse-power engine. The engine ran at 17½ revolutions per minute, and the maximum pressure was 4¾ pounds above atmosphere.

The next improvement in the development of the indicator was made by McNaught, who, about the year 1825, substituted a revolving and removable drum, to which the paper for recording the observations was fixed, in place of the flat board and sliding sheet of paper. The drum was driven from part of the parallel motion of the engine. As at first made there were no means of fastening the paper to the drum, and it was fixed by cement. The cylinder of this earliest McNaught indicator is 0.25 square inch in area, diameter of piston 0.5 inch, scale 1 inch = 20 pounds pressure above atmosphere. The drum is 1.5 inch diameter, and would give a maximum diagram of 3.4 inches high by 3.5 inches long. The spring is of flattened wire, with ends soldered to small brass nuts for screwing it on to the indicator piston and cover. It has ten turns of wire, the equivalent weight of the reciprocating parts is 0.135 pound, and of the whole instrument 1.77 pounds.

In a second McNaught indicator, of which there are three examples at South Kensington, one being shown at Fig. 3, the drum has pins and clips for holding the metallic paper, and the pencil is connected to the indicator piston by a hinged arm, instead of being affixed direct. Another feature of this indicator is that, although it carries a spring with a scale of higher pressure than hitherto used, viz., 1 inch = 10 pounds per square inch, there is a second spring above it, contained in a removable cap, by which higher pressures can be recorded, they are read to a different scale to that of the lower spring. There are signs here of improvement of the instrument in two directions. Watt himself always advocated the use of higher pressure steam than that used in the earlier engines, although he could not at the time command the skill requisite for constructing engines to bear it. As the pressures of steam increased, it became necessary to make the springs more powerful. At first, as in these three indicators, an additional spring was provided; this was afterwards discarded in favor of a single spring. As designed by Watt, the indicator was also not capable of following and recording modern speeds, and a parallel motion with levers was necessary. The arm to which the pencil was affixed in the early McNaught indicators was the first sign of this modification.

In the largest of the three McNaught indicators the cylinder is 0.5 square inch in area, with 4 inches stroke. The diameter of the drum is 2.2 inches, thus a maximum diagram of 5 inches high by 6 inches long was obtained. The permanent spring has 15½ turns of wire and the extra spring 7½, and the scale for the combined springs is 1 inch = 28.65 pounds per square inch. The weight of the indicator complete is 5.6 pounds. The two other indicators are both smaller, and practically of the same size, the cylinder area of each being 0.25 inch, with 2.5 inches stroke in the one, and 3 inches in the other. Both carry an additional spring for high-pressure engines. The drum of the smaller is 1.5 inches in diameter; the permanent spring has 13.25 turns of the wire, and the scale is 1 inch = 10.53 pounds per square inch. The additional spring has 10 turns and the scale is 1 inch = 21.06 pounds per square inch. The total weight of this indicator is 1.59 pounds. In the third instrument the indicator rod works through a cross head and guide slot and the spring-hinged arm attached to it carries the marker. The drum has a diameter of 1.9 inches. The permanent spring is soldered to the piston rod; it has 9.75 turns of wire, and a scale of 1 inch = 10.71 pounds per square inch. The additional spring has 8.25 turns of wire, and the scale of the combined springs is 1 inch = 51 pounds per square inch. Total weight of the instrument, 2.22 pounds.

Spiral Gear Designing Relieved of Uncertainty and Tedium.

BY W. H. CROKER.

Were spiral gears always mounted on shafts at right angles, I should have no need to come forward with a second article on the subject, as I believe that what was given at page 903, Vol. 23, fully dealt with the question, at least on a graphical basis. But the method therein set forth is not suitable for all angles between axes, and therefore lacks general application.

I think it will be conceded that the art is still involved in much vagueness, uncertainty and tedious tentative construction. These pages have contained many attempts by contributors who have trained the gun of trigonometry on the difficulties surrounding the subject and have fired a great deal of ammunition away in the form of "sines, cosines, tangents," etc.; but while the gun was all right and would shoot straight every time, yet if the mark is in a fog there is apt to be a number of lost shots. Now, I do not think that trigonometry is the pioneer weapon of attack, and I hope in this paper to be able to show that a little geometrical construction is all that is needed to place the subject on a sound basis and secure a reliable solution of any case, and by regular and positively progressive steps.

Let us now take up for an example a case having somewhat difficult requirements, the conditions being: Shafts at 80 degrees; center distance of shafts, 5 inches; velocity ratio, 3 : 7; and spur gear cutters to be used of 12 diametral pitch.

Referring to Fig. 1, *o x*, *o y* are the axes of the shafts; *o a* and *o b* are drawn square to these axes. I prefer to take a quadrant of each member of the pair of gears instead of the whole, as thereby the size of the drawing is reduced to one-quarter, which is no little consideration. With this understanding the first step is to obtain the starting dimension. This is the development of a quadrant with radius equal

to the center distance of the shafts—in our case 5 inches. Such development will be $\frac{C\pi}{2}$, in which C equals the center distance. Then $\frac{5 \times 3.1416}{2} = 7.854$ inches, which is the sum of any two gear quadrants we may decide on as the nature of the case may allow.

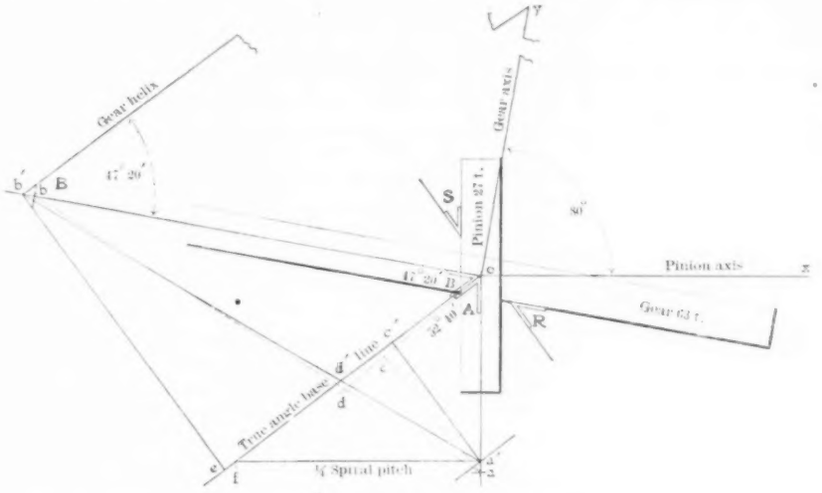


FIG. 1. SPIRAL GEARING: GENERAL CONSTRUCTION FOR ALL CASES AND CONDITIONS.

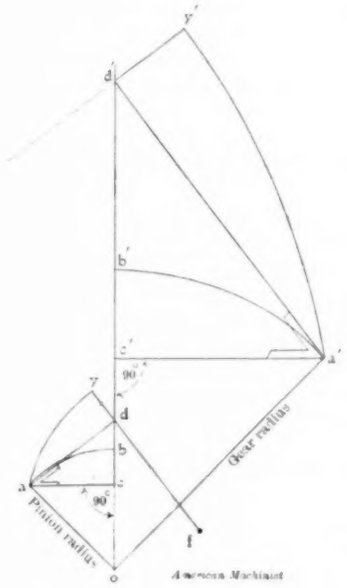


FIG. 2. THE HELIX FINDER.

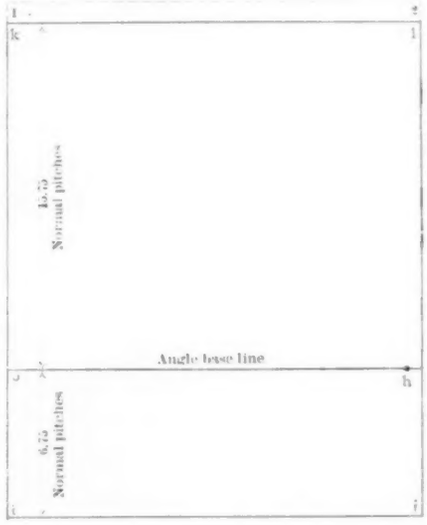


FIG. 3. GETTING THE CUTTERS.

Second Step.—In Fig. 1 let $a\,o + o\,b = 7.854$ inches, as above obtained, and let the legs $o\,a$ and $o\,b$ be in the ratio of 3 : 7, which will make $a\,o = 2.3562$ inches and $o\,b = 5.497$ inches. Join a and b by the dotted line shown. Add the terms of the ratio together, as $7 + 3 = 10$, and at three-tenths of $a\,b$ from a mark point d on $a\,b$; $a\,d$ must be from the $a\,o$ leg side, so as to agree in ratio relatively to each leg $a\,o$ and $o\,b$ of the angle $a\,o\,b$. Join d and o, giving $d\,o$ the preliminary angle-base. Draw $a\,c$ square to $o\,d$. Measure $a\,c$, which we find to be 1.8 inches; then $1.8 \times 4 = 7.2 =$ whole normal trial measure of the pinion quadrant. The normal pitch is .2618 inch; then $\frac{7.2}{.2618} = 27.5 =$ the whole number of teeth in the pinion; but as we cannot entertain the fraction we must adopt 27 and thank our stars that our pinion number is a multiple of 3, otherwise it would mean a violent jump by 3's in the pinion and 7's in the gear, owing to the two prime numbers of the ratio. The number of teeth in the mating gear is $\frac{27 \times 7}{3} = 63$.

Third Step.—Fig. 2 shows the helix finder, which is an instrumental device for determining the "True Angle Base Line." It is simply a piece of paper with the Angle Base Line first laid down as $o\,h$ and of any suitable dimension for its purpose. Set off from o to i $6\frac{3}{4} = 6.75$ normal pitches for the pinion quadrant and draw $i\,j$ parallel to $o\,h$. Also from o to k lay off $15\frac{3}{4} =$ 15.75 normal pitches for the gear quadrant. Draw $k\,l$ parallel to $o\,h$. Place the helix finder over Fig. 1 with a needle through some convenient point on the angle base line, as at h, and fix in position with the needle on point o of Fig. 1. Now move the helix finder about on the needle and o as a center till $i\,j$ and $k\,l$ intersect leg $o\,d$ in a' and $o\,b$ in b' in such manner that $a\,a'$ shall be subtracted from $a\,o$ and $b\,b'$ shall be added to $o\,b$, $a\,a'$ and $b\,b'$ being equal, so that $a'\,o + o\,b'$ shall equal $a\,o + o\,b$. Now prick in the points a' and b', also a point at, say e, from any point on the angle base line of the helix finder, so that when the helix finder is removed these points may be known. Distances $a\,a'$ and $b\,b'$ may be made equal by checking back and forth with dividers. Connect $a'\,b'$ and draw $o\,e$ the True Angle Base Line; then will intersection at d' be $\frac{3}{10}$ of $a'\,b'$ from a', while $a'\,c'$ and $b'\,e$ square to $o\,e$ are of course equal, respectively, to the normal measures of the pinion and gear quadrants $= 6.75$ and 15.75 normal pitches. The paper helix finder may be made transparent by moistening with turpentine.

We have now $o\,d'$ and $o\,a$ giving the pinion tooth angle marked $A = 52°\ 40'$ and $o\,b'$ and $o\,e$ giving the gear tooth angle marked $B = 47°\ 20'$. The ¼ spiral pitch of pinion is $a'\,f$, which is drawn square to $o\,a$. If at b' we draw an angle $= 47°\ 20'$ or parallel to angle base line, it would meet $o\,y$ in point y (broken to save room), but as this point may be often at an inconvenient distance, we may find it by trigonometry. Then $o\,y$ is equal to one-fourth of the spiral pitch of the gear $=$ tan. $B \times o\,b' = 1.085 \times 5.635 = 6.116$. Similarly $a'\,f$ may be computed, as it equals tan. $A \times o\,a'$.

The diameter of the pinion may be found from $o\,a'$, which is the development of its quadrant. Obviously the pinion diameter $= \frac{o\,a' \times 4}{3.1416} = \frac{2.216 \times 4}{3.1416} = 2.82$ inches. Obviously also, the gear diameter is equal to twice the center distance less the pinion diameter—that is, $10. - 2.82 = 7.18$ inches.

I do not think it necessary to enlarge on the possibilities of the construction shown in Fig. 1. The method will be found to work out satisfactorily, and only needs to be studied to make it suitable to all cases of spiral gearing.

Should one leg of the angle of developments not be in ratio with the other, proceed as if it were. Always join the initial extremities of the legs of development and divide according as the ratio requires; that is, if the ratio is 1 : 2 divide into three parts and draw preliminary angle base line through the first division as required by the nature of the leg ratio.

In Fig. 4 is given a case with shafts at right angles according to the conditions presented in the article by Mr. Bruce at page 345, Vol. 23. In that case the pinion diameter was, for some reason, stated to be "about 4 inches." Center distance of shaft, 5.5 inches; shaft angle, 90 degrees;

ratio, 2 : 5; cutters of 8 diametral pitch. The lettering of Fig. 4 is the same as of Fig. 1, so that readers can use the wording for Fig. 1, but of course bearing in mind the differences in ratio and pitch. The first step is to make $o\,a$ the pinion leg of Fig. 4 equal the quarter development of the proposed 4-inch diameter pinion, and $o\,b = \frac{5.5 \times 3.1416}{2} - a\,b$. The rest is fair sailing by following the instructions given for Fig. 1. It will be noticed that $a\,a'$ is additive to the pinion leg $a\,o$ and $b\,b'$ subtractive of the gear leg $o\,b$, the helix finder bringing about the opposite result, in this respect, from what it did in Fig. 1. Computing $a\,c$ of Fig. 4 gives 18 teeth for the pinion, therefore make $o\,i$ on the helix finder equal 4.5 normal pitches, which happens to be the same as the 6.75 for Fig. 1. The gear will require 45 teeth, so make $o\,1$ on the helix finder = 11.25 normal pitches; when, applying the helix finder to Fig. 4, the points a' and b' are then found. I have shown what the resulting angles are—in every case they have been determined by an ordinary protractor reading to whole degrees, the minutes being read by estimation. The terms of the ratio being $2 : 5$, $a\,d$ is $2/7\ a\,b$.

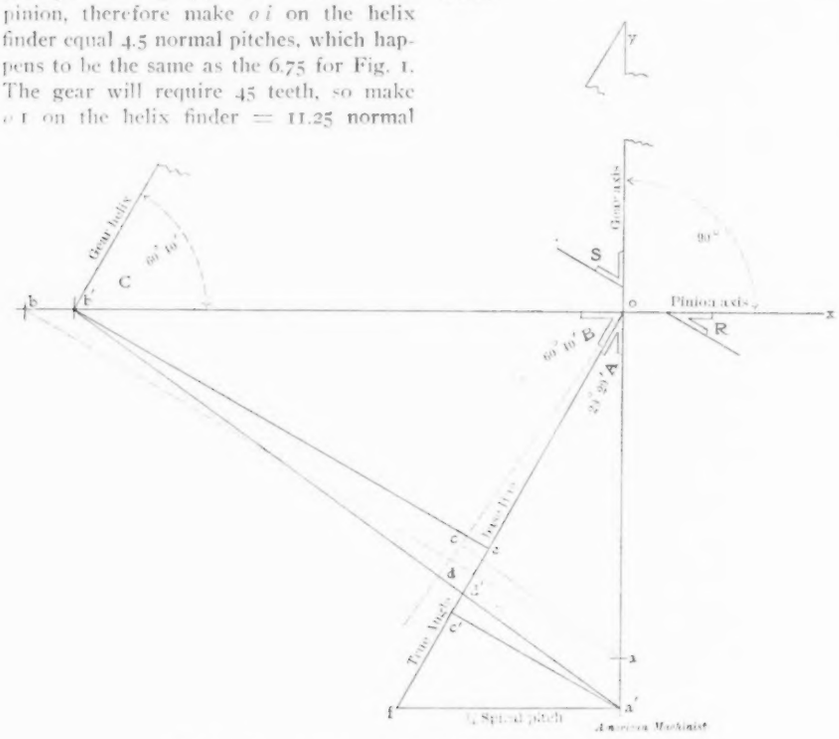


FIG. 4. RIGHT-ANGLE SHAFT CASE GIVEN BY MR. BRUCE.

To determine the cutters to be used for the first case, draw first the line $R\,S$, Fig. 1, square to the true angle base line giving the angles indicated. $R\,S$ being square to $o\,c$, it is the line of normal section of the teeth and the angles indicated are the angles of the normal helixes. Turning now to Fig. 3, draw $o\,d'$ and from o as a center draw octants of the pinion and gear as shown. From a draw $a\,d$ to the angle S, Fig. 1. Make $y\,d\,f$ square to $a\,d$, and on $d\,f$ find center f to strike arc $a\,y$. Then $y\,f \times 2 \times$ diametral pitch gives the number of teeth to be used in choosing the cutter for the pinion. As $y\,f$ equals about $2\frac{1}{8}$ inches, $2\frac{1}{8} \times 2 \times 12 = 51$; showing that a spur gear cutter of 12 diametral pitch to cut 51 spur teeth should be used for the pinion of 27 teeth.

Similarly, for gear requirements we have $a'\,d'$ drawn to the bevel shown at R, Fig. 1, and make $d'\,y' = c'\,b'$. To find the center on $y\,d$ produced would sometimes reach out to an inconvenient distance. In such case we may obtain the equivalent spur gear diameter by the formula:

$$\text{Diam.} = \frac{a'\,d'^2 + d'\,y'^2}{d'\,y'} = \frac{4.13^2 + 1.02^2}{1.02} =$$

16.84 inches, and $16.84 \times 12 = 202.08$; so we should use a cutter for the gear that would be right to cut a spur gear of 202 teeth.

By the way, in the historical example given by Mr. De Leeuw at page 30, Vol. 23, he states that the pinion and gear should be cut with the same cutter, but by the construction I have here it would require different cutters—a No. 2 for the pinion and a No. 3 for the gear.

Orillia, Ont., Canada.

Echoes From the Oil Country.

A RUSTED ENGINE AND A WORTHLESS BOILER —TO KEEP A STEAM PUMP FROM RUSTING.

"I am sending an engine in that I want a little work done on. There isn't much wrong with it, only it has been standing still for some time and I suppose the valve is stuck fast. It is one of those valves, in two parts, that slide together with one part pushing on the steam-chest cover, and they will stick sometimes when they get rusty. If I was going to use the engine myself I would get along without sending it in, but we sold it to Johnfry and I want things so he can't do any complaining."

It was one of our regular customers who was talking.

"Don't put a bit of unnecessary expense in it, as I had to sell it cheap to sell at all. Just tear it apart and see that it will run and touch it up a little where it is rusted. You may have to scrape a little on the valve. I will pay for it, but you let Johnfry's man have it when he comes for it."

Those were the directions we received, and in a few hours the engine was on the floor being torn apart. It was rusty, very rusty, and had evidently been lying idle for a long time, and a bad thing for it, too, as it had been lying partly full of water all the time. The cylinder bore had not suffered so much, but on the valve and valve seat there was a deep streak just where the top of the water had come. This streak was not very wide, just a thin crack, but it was nearly 1-32 inch deep, and was on both faces of the valve as well as on the valve seat and steam-chest cover. The two parts of the valve were rusted solid, and it took an all night's soaking to get them apart and get the ring that served as packing loose in its groove.

To plane off the valve faces and cylinder and steam-chest cover meant quite an expense and one we hardly felt justified in putting on to the job. The crank shaft boxes we found in horrible condition, being all of ¼ inch loose, but I did not assume the responsibility of babbitting them until I had called the shop owner's attention to them and was told to go ahead and was also told not to do more than loosen up the valves.

Just as I was getting ready to leave, one evening several weeks after the engine had gone out, Mr. Johnfry came in with blood in his eye and thunder in his voice and began to read the riot act to me. For a man that was well educated and did not swear nor talk vile and coarse, I think he was able to talk about the worst I had ever been in line with. His knowledge of mechanics was about equal to my knowledge of the surroundings of the north pole, but the volume and force of his language compared favorably with an oil well just after it is "shot," and, like the well, it was apt to smear anyone that was close enough.

Mr. Smith came in for a share of the abuse when he came up and tried to pour oil on the troubled waters and to find out what was really the trouble. I had tried to explain how the valve was made, and I suggested that perhaps the valve had been driven together by water in the cylinder not having time to escape by the pet cocks, a thing that style of engine had a trick of doing if started quickly without being warmed up. Generally a jar on the valve stem would seat it again, though.

"Why, young man, you don't know anything about how that valve is made; you never had it apart; my nine-year-old boy could make a better valve out of wood

with his jack-knife. You have shut us down for three weeks and our wells are good for a hundred barrels a day. This is a clear case of steal. I don't know which are the worse, you fellows in here or Moore (the man he had bought the engine from). The law should prohibit such people doing business and imposing on the community."

These were a few of the things he said, but I have no way of representing the sneering, aggravating way in which they were said. I suggested that some of the trouble might be with the boiler.

"Boiler, boiler; yes likely, isn't it? That boiler has run an engine for years that would do more work than six of this kind you fix. Ten boilers wouldn't furnish steam enough to run it. Don't think for a minute, young man, that I don't know anything. My nine-year-old boy could tell you more about machinery in a minute than you know altogether, and I don't think you are honest enough to learn."

Really I wanted to hit him. In all my experience with all sorts of people, I never felt more like fighting than I did then. He was little and the gray was streaked through his hair, so fighting was out of the question, and I walked away leaving him and Mr. Smith to settle it as best they could. Mr. Smith told me next morning he thought it best that I should go and see what really was the matter. This meant first a walk of a mile and a half to the house of the pumper, who, it was arranged, should go with me; then a walk of about two miles to the "lease." The last half mile was climbing up a hill about four hundred feet high. A light, soggy snow did not make things any pleasanter.

Arriving at the lease, I found a small portable boiler with the sky for a covering and a smokestack not more than 10 feet long, with several holes rusted in it. The flues were so dirty the smoke had a hard time getting through even in small quantities, while a number of them were plugged with wooden plugs cut from saplings. The door of the smokebox was held as near shut as it would go by a rail leaning against it, and there were several leaks besides those in the flues. The engine was about 50 feet away, also in the open, and was connected to the boiler by a 2-inch line made of old tubing. To run the engine it was necessary first to fill the boiler through the safety valve with a pail, then get up steam and run as long as the water would last, then let the steam run down and fill again.

From the pumper I learned that the boiler had been moved from a boiler-house farther down the hill, where it had failed to furnish steam enough for the smaller engine that there had sat beside it. The smokestack had dropped to pieces in taking it down, and so only the longest piece was used again, making it about half the former length.

Two hours firing did not give us a good head of steam, although I had rigged up a flue cleaner out of a piece of old rubber belt and cleaned the flues so that a little smoke came through most of them and had plugged a couple more flues that were leaking badly. At first I had been rather afraid of the boiler, but after being around a while I began to think it would be impossible to generate steam fast enough to blow it up. It was nearly noon when we got 40 pounds on. At that pressure the valve on the engine was tight enough to leak very little—a great deal less than the joints in the pipe running to it did. The engine would run about twenty minutes while the steam ran steadily down. When the engine would stop I could hear a distinct whistle through the valve, but it did not let through enough steam to show outside, and the engine was without any exhaust pipe, so it was very little. To stop it entirely would only be a drop in the bucket compared with the waste there was in other places.

The pumper could see how things were, but was not greatly to blame, as he could not get anything to work with, and was abused if he suggested it, so he thought his only hope was in what I could do for him. I heard that this lease was owned by Philadelphia parties who never came near it, but left its management to Mr. Johnfry entirely. I heard later that it was considered a fair property, but in the poorest shape of any in the county. Still later I heard that the company had sold the lease because the wells were so small they didn't pay expenses. The man that bought them had an idea that the manager was smaller than the wells, and I thoroughly agree with him.

That engine and boiler never pumped the one well properly, and things were never arranged so that it could, yet the manager is a fine-looking man and can talk very nicely when not talking to a machinist, and he has the name of being a well-educated man. An oil lease is something like a tannery in one way. As I was walking through a tannery I stopped to watch a big Swede moving hides from one vat to another. He straightened his back for a moment and stetched up his brawny arms in an effort to get the kinks out of himself, then seeing me he remarked: "Mister, it takes lots of muscle to work in a tannery."

Don't try to make an oil lease pay if you're looking for a soft snap, for your only hope would be a gusher, and they are like angels' visits, and always bigger and more plentiful in the newspapers than elsewhere.

I found one man who had a steam pump that was used only a few months in the summer, yet he never had any trouble with rust. He believed in using tallow, and got his supply a year ahead. When the season was over he drained the pump thoroughly, warmed it up, melted the tallow and poured both steam and water ends full. He was thus sure of a supply of tallow for the next season and also had less trouble getting his pump in shape than if rusted by seven or eight months' idleness. Steam easily melted out the surplus tallow.

We never got paid anything for my trip out on to the hills, but I would not complain if I had a picture of that boiler.

W. OSBORNE.

Graphic Integration—Area, Center of Gravity Moment of Inertia, etc.

BY KARL G. HOLST.

If the curve $O D_1 D_2 D_3$, Fig. 1, is so drawn that its ordinates $D_1 E_1$, $D_2 E_2$, etc., when measured by a certain linear unit, represent the respective areas of the figures $O C_1 E_1$, $O C_2 E_2$, etc., enclosed by these ordinates, the X axis $O X$, and the curve $O C_1 C_2 C_3$ and measured by the corresponding square unit, then, in the language of the calculus, $O D_1 D_2 D_3$ is an integral curve of $O C_1 C_2 C_3$. The latter curve is called the differential curve of the former, because any one of its ordinates $C_1 E_1$, $C_2 E_2$, etc., represents the differential coefficient of the curve $O D_1 D_2 D_3$ at points D_1, D_2, D_3, respectively. Calculus teaches us that the area between a curve $O C_1 C_2 C_3$ and the X axis is such a function of x that y is its differential coefficient, and $O D_1 D_2 D_3$ is a curve representing this function. Any area $C_1 E_1 E_2 C_2$, between two ordinates, is evidently represented by the difference $D_2 E_2 - D_1 E_1$ of the limit ordinates.

Graphic integration is then the process of finding a curve with the properties of $O D_1 D_2 D_3$ with regard to a given curve. The following is an approximate method of drawing an integral curve that has been devised by the writer and which may be new:

Let $O C_1 C_2 C_3$, Fig. 2, be the given curve. Draw the ordinates $C_1 E_1$, $C_2 E_2$, etc. Draw $P_1 S_1$, $P_2 S_2$, etc., parallel to $O X$, and at such distances from it that, judged by the eye, the area $P_1 R_1 O$ equals the area $C_1 R_1 S_1$, and so on. This can be done without any great error by drawing a few trial lines and choosing the one that seems most satisfactory.* We can then assume the area of the rectangle $P_1 S_1 E_1 O$ to be equal to that of the figure $C_1 O E_1$, $P_2 S_2 E_2 E_1$ to be equal to $C_2 C_1 E_1 E_2$, etc. From E_1, E_2, E_3, etc., lay off $E_1 U_1$, $E_2 U_2$ and so on, each equal to the linear unit of measurement. Join $S_1 U_1$ and draw $O D_1$ parallel to this line. Then

$$D_1 E_1 : E_1 O = S_1 E_1 : E_1 U_1$$

or

$$D_1 E_1 \times E_1 U_1 = S_1 E_1 \times E_1 O$$

= area of rectangle $P_1 S_1 E_1 O$, which is equal to the area $C_1 O E_1$. Dividing by $(U_1 E_1)^2$ we get

$$\frac{D_1 E_1}{U_1 E_1} = \frac{\text{area } C_1 O E_1}{(U_1 E_1)^2}$$

which means that $D_1 E_1$ contains as many

*It may also be done by stretching a fine thread over the figure and adjusting it unt l the two areas appear to be equal and then locating the point where the thread crosses the curve.—ED.

linear units as the area $C_1 O E_1$ contains square units. Hence D_1 is a point on the integral curve. Next draw $D_1 D_2$ parallel to $S_2 U_2$. Then drawing $D_1 T$ parallel to $O X$ we find:

$$D_2 T : D_1 T = S_2 E_2 : E_2 U_2;$$

or

$$\begin{aligned} D_2 T \times E_2 U_2 &= D_1 T \times S_2 E_2 \\ &= E_1 E_2 \times S_2 E_2 \\ &= \text{area } C_2 C_1 E_1 E_2. \end{aligned}$$

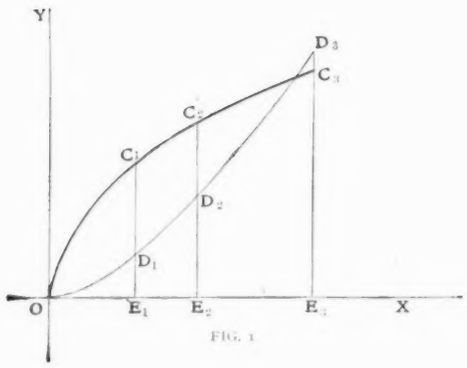


FIG. 1.

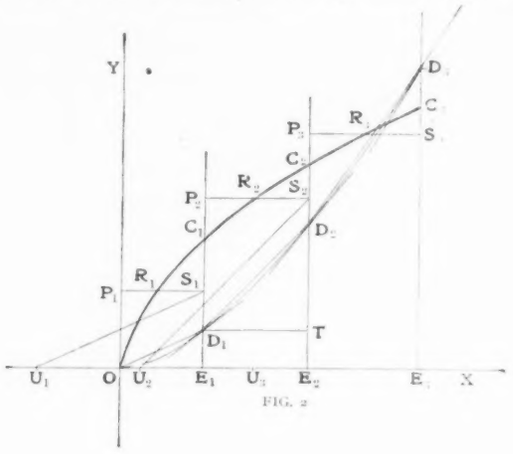


FIG. 2.

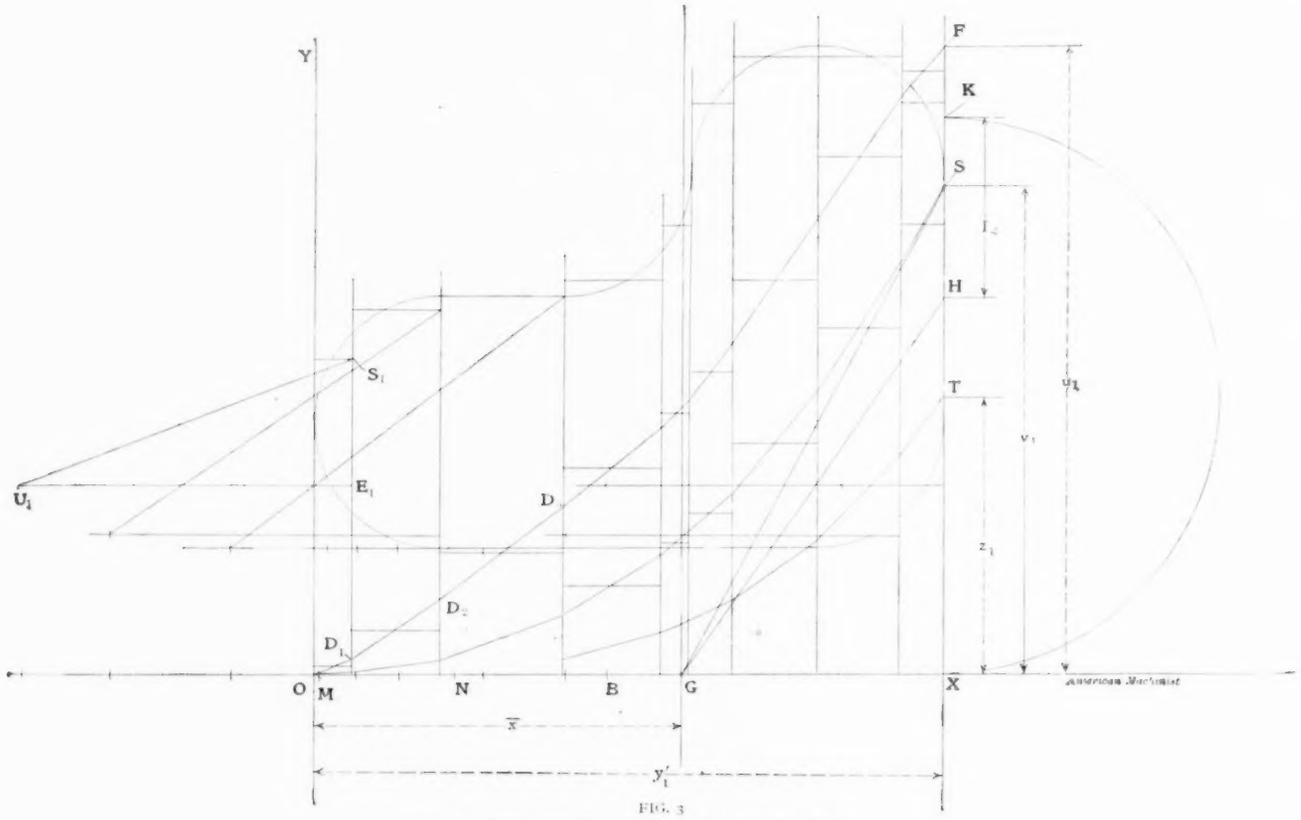


FIG. 3

GRAPHIC INTEGRATION OF PLANE FIGURES.

Dividing by $(E_2 U_2)^2$ as before, we have:

$$\frac{D_2 T}{E_2 U_2} = \frac{\text{area } C_2 C_1 E_1 E_2}{(E_2 U_2)^2}$$

Therefore, $D_2 T$ represents the area of the figure $C_2 C_1 E_1 E_2$, and $D_2 E_2$, which is equal to $D_2 T + D_1 E_1$, similarly represents the area of the figure $C_2 C_1 O E_2$. Consequently D_2 is another point on the integral curve. Other points D_3, D_4, etc., can be found in the same manner. Through the points thus found we can easily draw tangents to the integral curve, as the tangent through D_1 must be parallel to a line joining C_1 and U_1, and so on. This is because the ordinates $C_1 E_1$, $C_2 E_2$, etc., represent the differential coefficient of the integral curve. Aided by these tangents we can draw the integral curve pretty accurately with a small number of ordinates.

When we wish to find the area of a given figure, we can draw the rectangles as in Fig. 3 and lay off the unit distances from E_1 to U_1, etc., as shown.* We can then start from any point O on $O Y$ and draw $O D_1$ parallel to $S_1 U_1$, etc. We thus obtain a single integral curve, the ordinates of which will represent the area in the manner stated above. We can then integrate this curve in its turn, and so on. This is necessary in order to find the center of gravity and moment of inertia. The second and third integral curves can be made more accurate by introducing new ordinates where the increased slope of the curves makes such a thing desirable.

In Fig. 3 $F X$ is the last ordinate of the first integral curve, $S X$ that of the second and $T X$ that of the third. $B X$ is equal to the linear unit. Draw $S G$ parallel to a line joining F and B, and a line through G drawn parallel to $O Y$ will pass through the center of gravity of the figure. Draw

*In the author's original drawings the distances $E_1 U_1$, etc. were made equal to one inch in all the figures. This resulted in a somewhat crowded condition in Fig. 3 and that figure has therefore been enlarged. As the author explains, this distance is to be considered as unity in all cases.—ED.

$G\,H$ parallel to a line joining S and B and lay off $T\,K$ equal to $T\,X$ then the distance from H to K represents the moment of inertia of the figure around the gravity axis through G. Another way to find the point H is to lay off $M\,X = F\,X$ and $N\,X = S\,X$ and from N draw a line parallel to one joining M to S. This line will pass through H.

To prove the foregoing, let us designate the *numerical* values of the ordinates of the original curve or figure, and those of the first, second and third integral curves by the variables y, u, v and z, respectively. We find the distance x of the center of gravity from $O\,Y$ by adding together the products of the areas $y\,dx$ of infinitely narrow strips parallel to $O\,Y$ with their respective distances x from $O\,Y$, and dividing this sum by the whole area, or, in other words, by integrating $xy\,dx$ between the limits $x = o$ and $x = x_1$, and dividing by u_1. As u is the integral of $y\,dx$, $y = \frac{du}{dx}$. Similarly we have $u = \frac{dv}{dx}$ and $v = \frac{dz}{dx}$. $\int xy\,dx$ can therefore be written $\int x\frac{du}{dx}dx$. Integrating the parts we get:

$$\int xy\,dx = ux - \int u\frac{dx}{dx}dx$$

$$= ux - \int u\,dx$$

$$= ux - v$$

$$\int_o^{x_1} xy\,dx = u_1x_1 - v_1$$

$$\bar{x} = \frac{u_1x_1 - v_1}{u_1}$$

$$= x_1 - \frac{v_1}{u_1}$$

As $S\,G$ is parallel to $F\,B$, we have:

$$\frac{G\,X}{B\,X} = \frac{S\,X}{F\,X} \text{ or } \frac{G\,X}{1} = \frac{v_1}{u_1}$$

$O\,G$ is therefore equal to $x_1 - \frac{v_1}{u_1} = \bar{x}$.

The moment of inertia about $O\,Y$ is:

$$I_o = \int x^2 y\,dx$$

$$= \int x^2\frac{du}{dx}dx$$

$$= ux^2 - \int u\frac{d(x^2)}{dx}dx$$

$$= ux^2 - \int 2xu\,dx$$

$$= ux^2 - 2\int x\frac{dv}{dx}dx$$

$$= ux^2 - 2(vx - \int v\,dx)$$

$$= ux^2 - 2vx + 2z$$

Putting between limits, we have the moment of inertia of the whole figure about $O\,Y$ equal to

$$u_1x_1^2 - 2v_1x_1 + 2z_1.$$

To find the moment of inertia I_g around the center of gravity, we subtract the area multiplied by the square of the distance $O\,G$, or $u_1\bar{x}^2$. Hence:

$$I_g = u_1x_1^2 - 2v_1x_1 + 2z_1 - u_1\bar{x}^2$$

$$= u_1(x_1^2 - \bar{x}^2) - 2v_1x_1 + 2z_1$$

but $\bar{x} = x_1 - \frac{v_1}{u_1}$

and $\bar{x}^2 = x_1^2 + \frac{v_1^2}{u_1^2} - \frac{2v_1x_1}{u_1}$

therefore

$$x_1^2 - \bar{x}^2 = \frac{2v_1x_1}{u_1} - \frac{v_1^2}{u_1^2}$$

and $I_g = 2z_1 - \frac{v_1^2}{u_1}$.

As $XT = TK$

$XK = 2z_1$

$HX : GX = SX : BX$

hence $HX = \frac{GX \times SX}{BX}$.

But $GX = \frac{v_1}{u_1}$, $SX = v$ and $BX = 1$

therefore

$$HX = \frac{v_1^2}{u_1}$$

and $I_g = 2z_1 - \frac{v_1^2}{u_1}$

$= KX - HX$

$= KH$

This process of integration can also be applied to solids. Let, for example, $O\,A\,B$ in Fig. 4 be a solid body, of which $C\,D\,E$ is a side view. We can then erect ordinates on $O\,B$ which by their lengths represent the areas of the sections on C_1F_1, C_2F_2, etc. In the present case their lengths can be found from H_1K_1, H_2K_2, etc., on an integral curve of $C\,D\,E$. Making $G_1F_1 = H_1K_1$, etc., and joining the points G_1, G_2, G_3, etc., by a curve, we obtain an area which represents the volume of the body. Integrating we obtain the line $L\,B$, which contains as many linear units as the volume does cubic units.

Suppose the unit used in the integrations contains l inches, and that the last ordinates of the first, second and third integral curves contain respectively u_1, v_1 and z_1 inches. We know then from the definition given of the integral curve, that

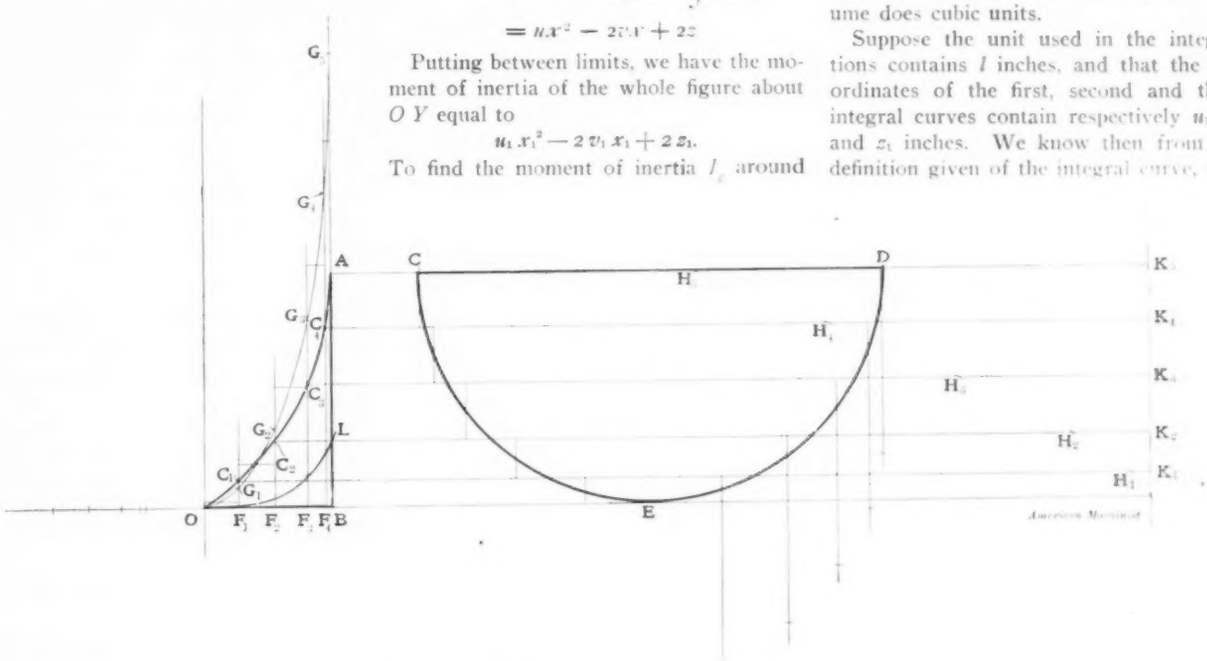


FIG. 4. GRAPHIC INTEGRATION OF SOLIDS.

$$\text{area of figure} = \frac{u}{l^2}$$

Multiplying by l^2 we get area of figure $= u_1l$ square inches. The quantity represented by v_1 is measured by the cube of the linear unit; hence it is equal to v_1l^3 cubic inches. Similarly the quantity represented by z_1 is equal to $z\,l^4$ inch units of the fourth power, etc.

If the figure were drawn to half size, the actual area represented by the figure would be four times the area of the figure. Suppose then that the linear unit used in drawing the figure contains s inches. The actual area will then contain $\frac{u_1\,l}{s^2}$ square inches. The quantity represented by v_1 will contain $\frac{v_1\,l^3}{s^3}$ cubic inches, and so on. The moment of inertia contains four linear dimensions as factors; hence to obtain its numerical value we must multiply by l^4 and divide by s^4. From these expressions we see that the greater the number of integrations the more necessary it is to

measure off the units accurately. We also find that the error will be smallest if we make s as large and l as small as circumstances will allow. It even pays to increase l and s in the same proportion.

If we try this method on figures whose areas, etc., can be easily calculated, we find that the values for the areas obtained by this graphical method are pretty accurate. The values for the moments of inertia, on the other hand, usually do not approach the theoretically exact values so closely. It should be remembered, however, that the moment of inertia varies with the fourth power of s; therefore a seemingly large variation in the moment of inertia represents a comparatively small variation in the linear dimensions of the figure. And it is usually the latter we wish to determine in problems connected with designing machinery.

A Self-Centering Steady-Rest.

BY E. C. THULIN.

To many machine shops the steady-rest is a valuable tool, and any improvement whereby time could be saved in adjusting it to various diameters would be gladly received by many manufacturers. The tool described in this article was designed to overcome this loss of time, by making a steady-rest that would be self-centering and easily opened to change work in the lathe. It is evident that this rest would not do for heavy work, but for rods of small diameter with light cuts it is a very desirable addition to the machine shop.

The body as well as the two uprights are made of cast iron, the jaws that come in contact with the work being of ½-inch tool steel. The general construction is clearly shown in the drawing and needs no further explanation. The adjustment of the uprights is made with a wrench on the end of the spindle, which may be the tool-post wrench. In assembling the parts of the rest it may come slightly out of true, and to correct this one upright has an adjustment.

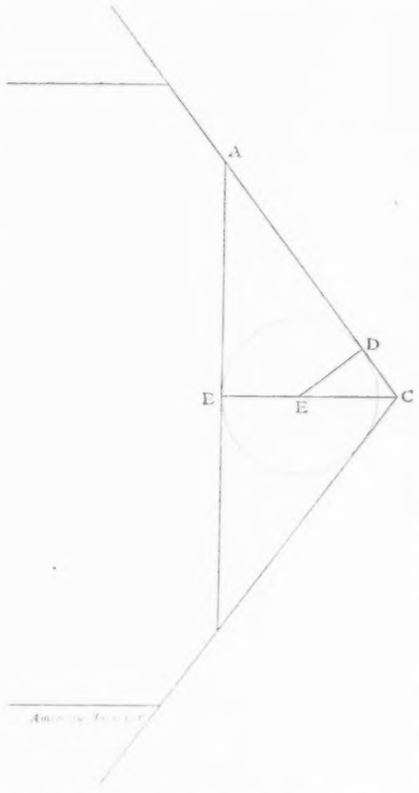


FIG. 2. GEOMETRY OF THE STEADY-REST.

The important part of this rest is the relation between the slant and vertical of the jaws and the threads on the spindle. It may have occurred to many that if the angle in the jaw was made more acute, the rest would make a better tool. So it would, but other difficulties arise which make it desirable to work to the angle shown here, as will readily be understood from Fig. 2 and the following explanation. The relation between the right- and left-hand threads on the spindle must be in the same ratio as that of the slant of the jaw to the vertical. Suppose the angle were made 45 degrees, then the threads would be to each other in the ratio of 1 to $\sqrt{2}$, to give which a special fractional thread would have to be cut on one end of the spindle. This objection has been overcome by making the triangle ABC with sides in proportion to 5, 4 and 3. Then we have:

$$AC : AB = 5 : 4.$$

The threads can be any multiple of these numbers and in this case they are 8 and 10 threads to an inch, left and right hand. The diameter of the smallest piece that can be held in this rest equals one-third the hight of the vertical jaw, and the curve in the apex of the other jaw should be of

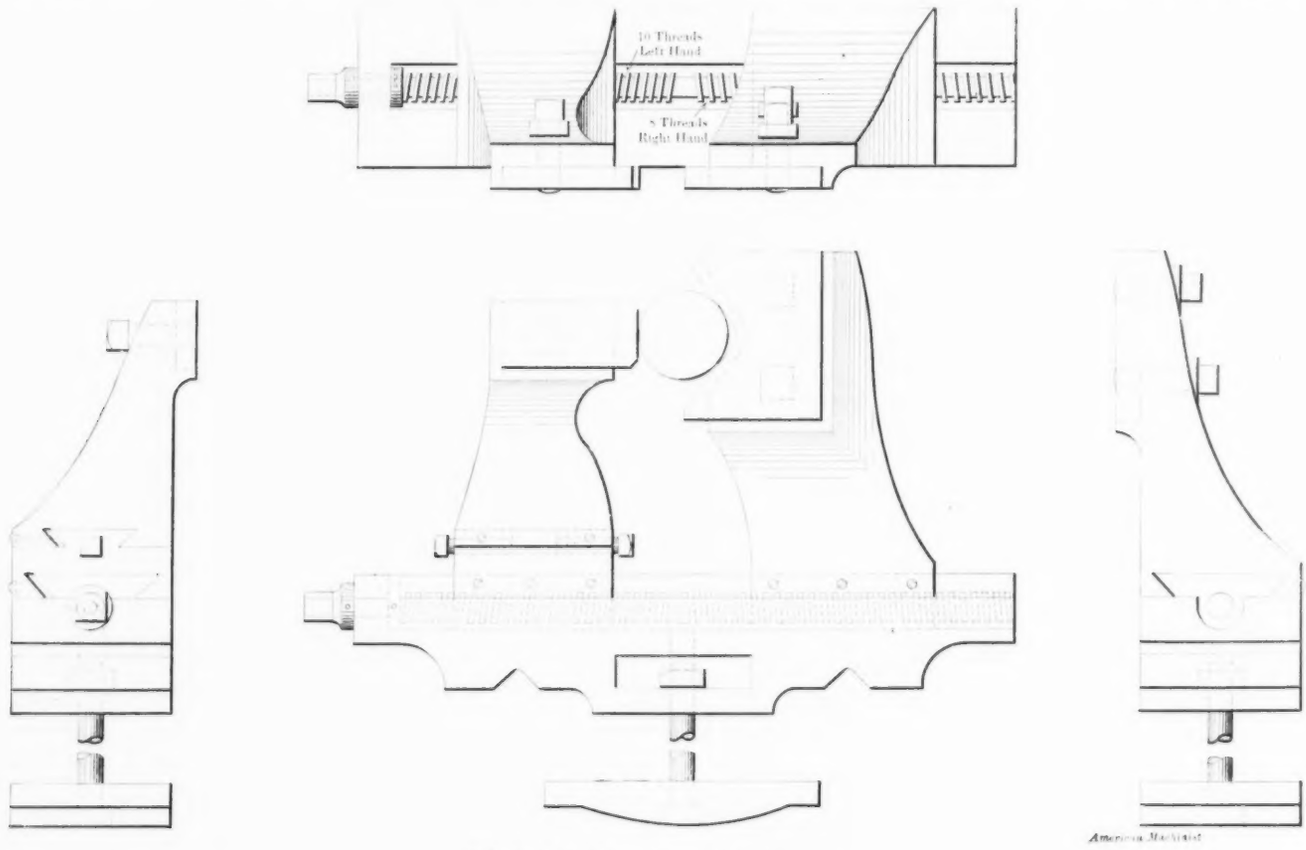


FIG. 1. A SELF-CENTERING STEADY-REST.

this diameter. To prove this the following algebraic explanation is offered to those who want to know "why."

To prove that $3ED = AB$:

$$AB : BC = 4 : 3$$

whence $BC = \frac{3}{4} AB$.

The triangles ABC and CDE are similar, and

$$ED = EB$$

$$ED^2 + DC^2 = EC^2$$

$$DC = \tfrac{3}{4} ED$$

$$EC = BC - EB \text{ (or } ED)$$

$$BC = \frac{3AB}{4}$$

$$EC = \frac{3AB}{4} - ED$$

$$ED^2 + \left(\frac{3ED}{4}\right)^2 = \left(\frac{3AB}{4} - ED\right)^2$$

$$ED^2 + \frac{9ED^2}{16} = \frac{9AB^2}{16} - \frac{6AB \times ED}{4} + ED^2$$

$$9ED^2 = 9AB^2 - 24AB \times ED$$

$$9ED^2 + 24AB \times ED = 9AB^2$$

$$9ED^2 + 24AB \times ED + 16AB^2 = 25AB^2$$

$$3ED + 4AB = 5AB$$

$$3ED = 5AB - 4AB$$

$$3ED = AB. \qquad \text{Q. E. D.}$$

This proves the proposition and shows that the diameter of the curve at the apex should be one-third the hight of the vertical jaw.

Many variations from the drawing here shown may suggest themselves to the reader, but a tool built on this general form should prove a valuable addition for work requiring a steady-rest.

The Philistine on Education.

We are not to any large degree admirers of *The Philistine*, but we confess to a good deal of sympathy with some opinions on education which we find in a recent number. These are so strikingly in harmony with Professor Higgins' plan for a half-time school that they might have come from the same source, although their fundamental aim is entirely different. *The Philistine* advocates a better general system of education, while Professor Higgins aims at bringing it within the reach of those to whom it is now denied. We believe that both are right. Our readers are well aware of our sympathy with Professor Higgins' plans, but more than this we believe in the soundness of *The Philistine's* contention that years of isolation from the world's work is a misfortune which works harm to many students. The long period of elaborate preparation serves to give some the exaggerated idea of their own importance of which we hear so much, while on many others the long deferring of the task of earning a living gives rise to a spirit of timidity and self-distrust. The boy who is pitched into the streets at a dozen years of age to earn his living by selling newspapers or polishing shoes has a confidence in himself which many a university graduate may well envy, but which they can acquire in but one way and that is the way in which the street boy has acquired it. This spirit of self-distrust is part of the price which many pay for their education and it is inseparable from education as commonly conducted. That Professor Higgins' type of school would go a long way, if not the entire way, to prevent it goes without saying, and this is by no means its least valuable feature. We quote from our sprightly contemporary as follows:

"To take a young man from work, say, at eighteen years of age, and keep him from useful labor, in the name of education for four years, will some day be regarded as a most absurd proposition. It is the most gigantic illusion of the age.

. . . . . .

"In the smaller college, especially in the West, many instances are found of students working their way through school. My experience leads me to believe that such students stand a very much better chance in the world's race than those who are made exempt from practical affairs by having everything provided. The responsibility of caring for himself is a necessary factor in man's evolution that must not be too long delayed.

"And the point of this preachment lies right here, that to make a young man exempt from the practical world, from eighteen to twenty-two, is to run the risk of ruining him for life. Possibly you have taken opportunity from him, and turned him into a mnemonic machine.

. . . . . .

"A school should not be a preparation for life—*a school should be life.*

"There never will be a science of pedagogy so long as you take the pupil from his work in order to educate him. Isolation from the world, in order to prepare for the world's work, is folly. You might as well take a boy out of the blacksmith shop in order to teach him blacksmithing. College is a make-believe and every college student knows it. From the age of fourteen upward, the pupil should feel that he is doing something useful, not merely killing time. And so his work and his instruction should go right along hand in hand. And this sort of education is given out in degree, in Purdue University, in the schools of technology, the various agricultural colleges, the Ferris Institute, by that strong and useful man, Beardshear of Iowa, and that other equally excellent man, Booker Washington, and by various others scattered here and there.

"But we will not approximate the perfect college until we have an institution where any boy can go and earn his own livelihood, and where he will not be humiliated by the operation. The students will be paid for their work, and then in turn they will pay for certain advantages, and thus the idea of mutuality, reciprocity and economy of time and money will be fostered and encouraged.

"The best lesson in life is the lesson of self-reliance, and the college that inculcates this best will approach the ideal."

British American Soap Mines.

A natural soap mine and a paint mine are two of the latest mineral discoveries in the Northwest. Several soda lakes have been found in the foothills near Ashcroft, British Columbia. Their bottoms and shores are incrusted with a natural washing compound, containing borax and soda. No two analyses agree exactly as to the composition of the material; a New York analysis gives 26 per cent. borax, while a Montreal chemist, from the same sample, gives 16 per cent. borax. Tests prove the substance to be equal to the washing powders in common use. Trials by blacksmiths and farm workmen show that it will remove grease and dirt quicker than soap. A syndicate of British Columbia men has been formed to put the product on the market. About 275 tons of the compound have been cut and taken out of the lake. It is handled precisely as ice is handled. The blocks are more than 9 inches in thickness, are sawn into pieces of 15 by 18 inches, and weigh 50 pounds each. It is estimated that this lake alone contains 20,000 tons, proving that the industry, if successful, will reach large proportions.—*Consular Reports.*

A Boy's Wages.

Speaking of boys, Sterling Elliott says: "I wanted to hire a boy. One called, and, after questioning him, I decided to have him come to work the following morning. As he was going out the door he said, 'How much pay will I get?' I replied, 'You will get whatever you are worth, and the more you are worth the better I shall like it.' Next morning I received a postal card from him stating that he thought best not to come as the pay was entirely too small."

The Omnimeter Annex.

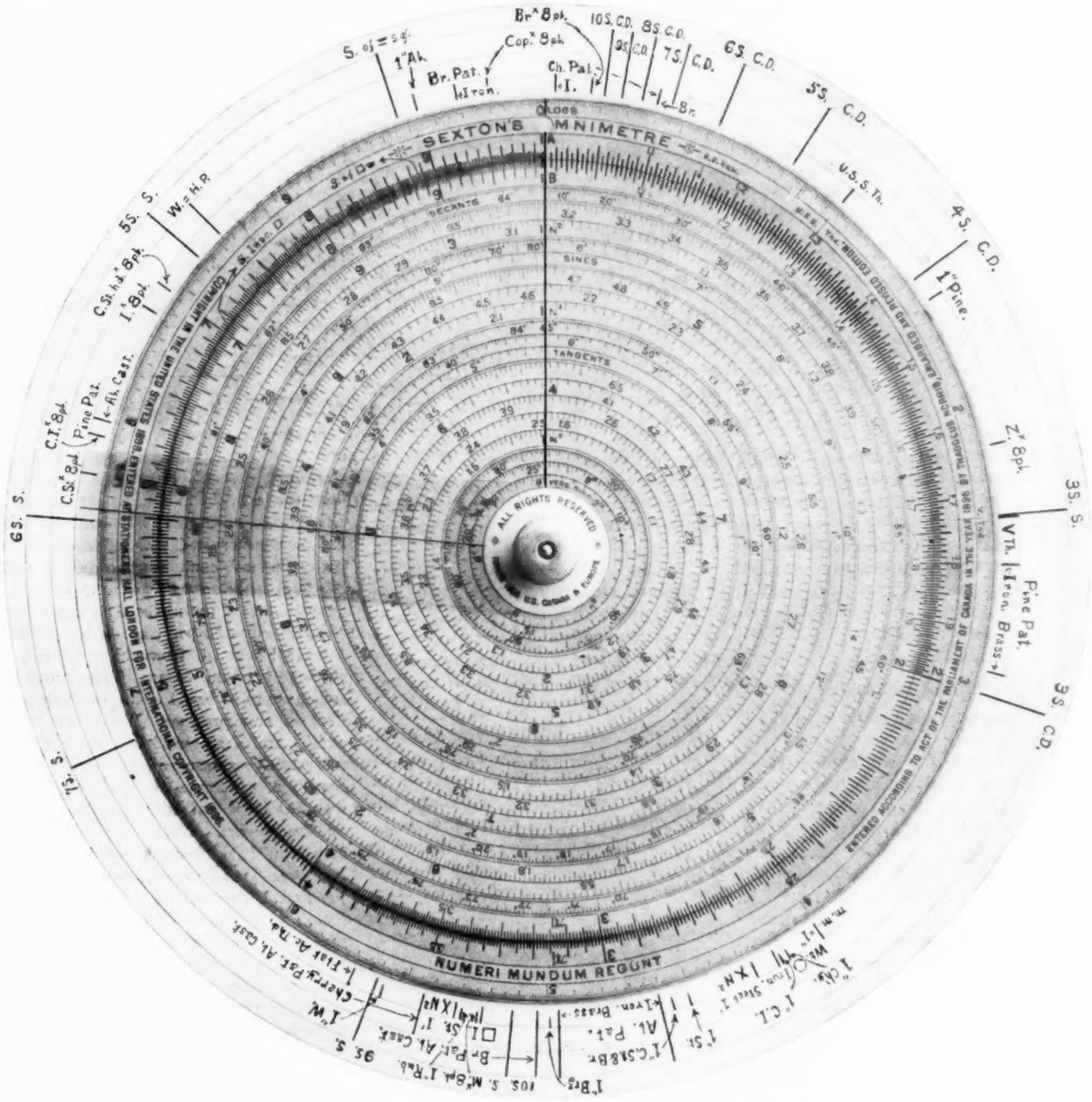
BY W. A. WARMAN.

The accompanying illustration and the following suggestions show a few of the possibilities of the omnimeter as a time saver in machine-shop and drafting-room calculations. The idea first suggested itself of putting marks on the instrument, as most everyone does on the slide rule. Then the idea of adding the outer circle of cardboard occurred to me as being more practicable. The scope is unlimited with this arrangement.

For instance, if it is desired to turn a piece to mill to a heptagon with a given width of face: Set the constant for 7 *S.S.* on *B* to the given width of face on *A*, and over 1 on *B* read the inscribed diameter. Set 1 on *B* to 7 *S.C.D.* and over the inscribed diameter on *B* read the circumscribed diameter. It is done before one can get his table of sines dug out, and at the same time almost all chances for error are eliminated. If we have a solid cherry pattern and want the weight of a casting in aluminum, it is only necessary to set 1 on *B* to the line marked cherry pat. Al. cast. over the weight of the pattern on *B* and read the weight of the casting on *A*.

In round and square bar iron and steel: Kent, Haswell, etc., give the weights per foot for diameters advancing by sixteenths. With the "annex," set 1 on *B* to the line for round or square iron or steel and read diameters, to thousandths if wanted, on the *N*° circle and the weights per foot on *A*.

I shall add the constants for brass, copper, etc., the first time I have occasion to look them up. I am constantly adding to these settings and offer this merely as a suggestion of the possibilities. Whenever I have to refer to a table or handbook, or figure out something, if practicable I add it to my settings on the "annex." For electrical and other branches of engineering, the convenient settings that may be added are innumerable. Everyone will have to arrange the "annex" to suit his work.



THE OMNIMETER ANNEX.

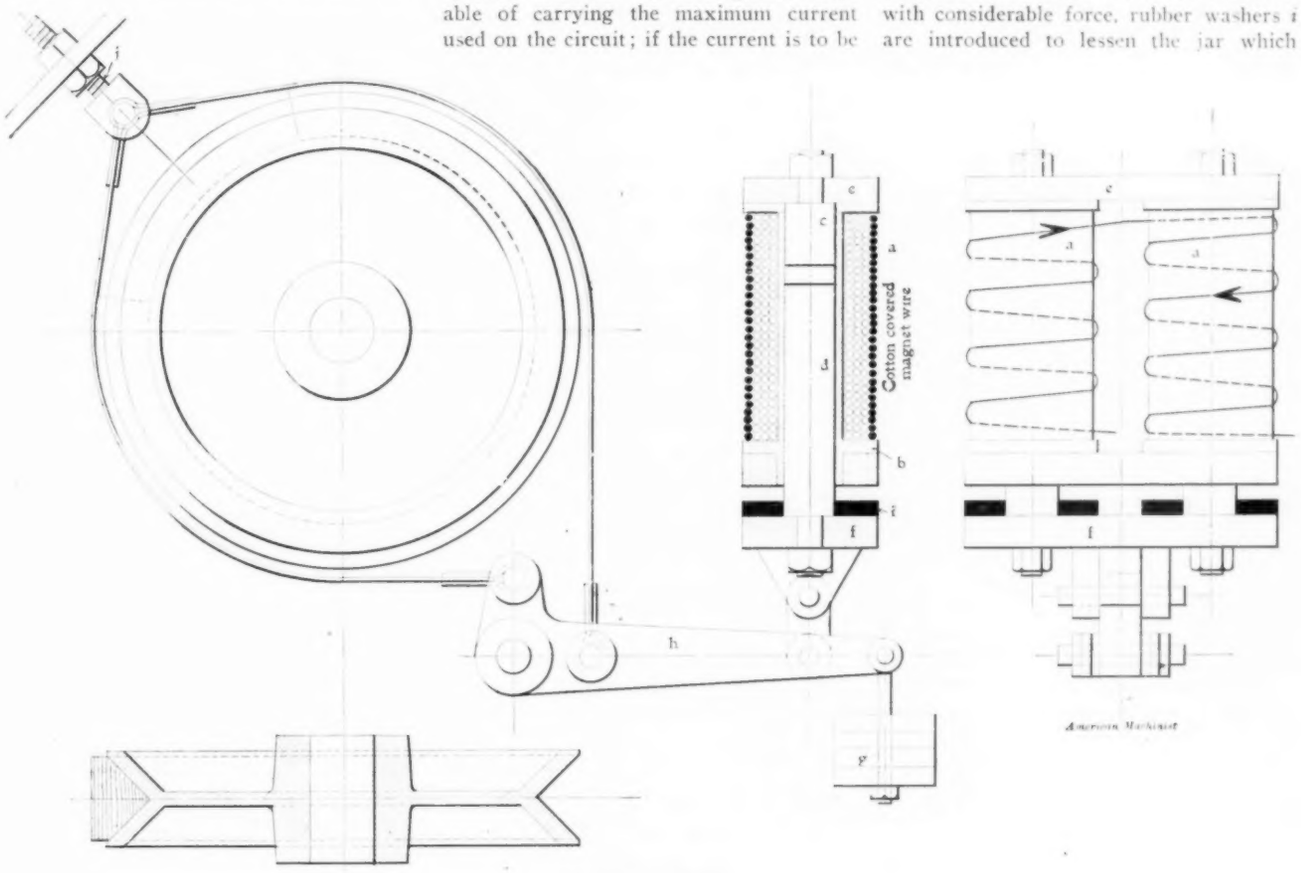
[The advantage of the omnimeter over the slide rule in the matter of adding gage points in the manner shown by Mr. Warman is certainly very marked. The room available on the slide rule for such gage points is limited, it is not easy to add them

neatly and one hesitates to disfigure the instrument. The addition of outside circles to the omnimeter gives almost unlimited room and the whole arrangement is obviously simple and practicable. The instrument was described at page 869, Vol. 20.—Ed.]

Magnetic Brakes.

BY GERALD E. FLANAGAN.

The action of magnetically operated brakes, such as are commonly used on electric traveling cranes is a profound mystery to the uninitiated, and serves as an apt illustration of how completely non-



MAGNETIC BRAKES.

plused one may be by even the simplest device when unfamiliar with the principles involved in its action or construction.

When a current of electricity is sent through a wire formed into a coil a magnetic force is developed, and a soft steel or wrought-iron core will be drawn into the coil if so arranged as to be free to move. This constitutes a simple electro-magnet. That is, it is magnetic only so long as the electric current is flowing through the wire, losing its force the instant the current ceases to act upon it, except for a trace of what is known as residual magnetism which still remains, due to imperfections of the material. It is this quality of being controlled by the action of the current which renders the electro-magnet available for the operation of various devices, including brakes. For this purpose the coils *a* are commonly used in pairs, made of cotton-covered soft copper wire wound upon brass spools *b* with additional insulating material between them and the wire, and containing fixed iron cores *c* as well as the movable ones *d*; each pair of cores being connected to iron yokes *e f*, thus forming a nearly continuous iron path for the magnetic force, which greatly increases the tractive effect. Care must be taken that both spools are wound in the same direction, as indicated in the sketch at the right, otherwise they will simply neutralize each other. If intended to be used in series with the motors, the spools are wound with a large wire capable of carrying the maximum current used on the circuit; if the current is to be shunted through the magnets, the wire is much smaller and the number of turns wound upon a spool is correspondingly increased; the point to be observed being that the magnets must operate with the smallest current used upon the circuit, and at the same time be capable of withstanding the maximum current that can by any possibility reach them.

When used for operating crane brakes, this device is arranged so as to render the action of the brakes automatic. When the current comes on, the brake is released, and when the current is cut off the brake applies itself. The amount of motion required in applying the brake being comparatively little, the weight *g* which is used for this purpose is generally applied at the end of a lever *h*, to which the lower and movable yoke of the solenoid or magnet is connected. The brake being applied by gravity acting upon the weight, the desired object of rendering the device automatic is attained. When the current is applied to the motor it also flows around the coils of the magnets, and the weight is instantly raised and the brake released; the instant the current ceases flowing, the coils then having no attraction for the cores, the weight drops and the brake is applied. It will be seen that the apparatus requires no attention whatever from the operator, except to see that it is kept in working order, being entirely self-acting. Since the movable cores which are connected to the brake lever are attracted with considerable force, rubber washers *i* are introduced to lessen the jar which would otherwise be produced by two metals striking together.

The more complete and perfect the iron path offered to the magnetic force, the greater will be the tractive effect, and for this reason the cores should be designed to approach each other as closely as may be without actually touching at the completion of the stroke, and the stroke should be limited to the amount actually required to freely release the brake. With a view to reducing this to a minimum, the brake bands are made adjustable as to length by a bolt *j*. The magnet cores should always be made of soft steel or wrought iron, since hard steel, under the influence of the electric current, acquires a degree of permanent magnetism which is not desirable. If the yokes are made of cast iron they should be of greater sec-

tion than the cores, as this material is less permeable to magnetic lines than wrought iron.

If the wheel rim is made of V-section, as shown in the cut, the band must be made in two parts to facilitate placing it in position, but when so desired the wheels may be designed to have the band continuously embrace nearly the entire circumference. They are often made, however, to encircle only one-half of the rim; in which case they should be applied to the lower side, as the band then falls away from the wheel when released. Of course the shorter the arc of contact between the band and the wheel the greater the force which must be applied to make the brake effective, and larger magnets will be needed to lift the weights required to produce this force.

American Triumphs—Machine Mortising.

We had thought that the intercourse with other nations which the Americans have enjoyed in recent years had tempered that exaggerated belief in himself for which the American was at one time justly celebrated. Apparently some of the old blood still remains. At any rate, justification for thinking so is to be found in an article in *Scribner's Magazine*, the perusal of which might leave the reader with the belief that everything in England of any value arrived there quite recently from America. May we recommend the following passage to English wagon and carriage builders: "Our car builders, who have so specialized the building of freight cars that the rough timber goes in at one end of the workshop and, almost under the eye of the spectator, comes out at the other end a finished car, found an easy market in competition with old-fashioned methods and hand labor. It is only within a few months that there have been in an English shop machines for boring square holes such as enable our car manufacturers rapidly to mortise timbers in car construction. The work that is done in an instant with a whirl of flying chips was laboriously bored and chiseled out by hand by the English workers." The statement contained in the second paragraph literally takes one's breath away! The mortising machine has been known in this country only a few months! At this moment there lies before us a catalog, that of Samuel Worssam & Co., of Chelsea, dated March 31, 1865, in which a mortising machine already brought to some perfection is illustrated. Some sentences from the description are worth quoting: "The patented improvement consists in the peculiar formation of the chisel, which is square, and is fitted with an auger made to revolve inside it. The end of the auger projects slightly beyond the edges of the chisel, and when brought down to the timber it bores a round hole, the chisel following it and simultaneously squaring out the four corners and sides." This was in 1865, and a writer has the assurance to tell us we did not know how to cut the mortises in a wagon frame a few months ago! If he had visited the works of the Great Western Railway Company or of the Midland, he would have found a plant at work manufacturing wagons, etc.—made by Thomas Robinson & Son, of Rochdale—which entirely dispensed with hand labor twenty-five to thirty years ago. Such wild statements as these—and there are others nearly as exaggerated or untrue—in the article make us, if we may use an American phrase, "feel tired." They are quoted and believed by persons who are, unfortunately, not so placed as to be able to check their accuracy, and damage the prestige and reputation of British trade. That is a sufficient reason for "nailing them to the counter."—*The Engineer.*

Bryan Donkin.

In the sudden death of Bryan Donkin, which we have previously announced, the engineering profession loses one of its most prominent and valued members, and a brief sketch of his life and work will be welcomed by many of our readers. Mr. Donkin, who was in his sixty-seventh year, was an engineer and scientist by heredity, being both son and grandson of able and successful engineers. The grandfather, whose name he bore, founded in 1803 large works at Bermondsey, in the heart of London, and was a perfecter and manufacturer of paper machinery. He also invented a remarkable dividing engine and collaborated in the preparation of a standard treatise on the steam engine.

Bryan Donkin was unusually favored in his education, attending the University College of London and the Ecole Centrale des Arts et Metiers at Paris, then serving an apprenticeship at the Bermondsey works and being sent to St. Petersburg in 1859 in connection with the establishment of the largest paper mill in Europe, his foreign residence bringing him into contact and acquaintance with the most eminent engineers of the day. He became a partner of the Donkin firm in 1868. The changes in the demands of business drew Mr. Donkin later away from the paper machine and into intimate association with the steam engine and led him into his special line of work. The firm introduced the Farey engine, the inventor being a man of high scientific attainments, and elaborate and up to that time unusual tests of the efficiency of this engine were undertaken. This was the first of the long series of engine tests which extended to the very end of Mr. Donkin's life. In this special line Bryan Donkin was distinctly a leader and teacher. *The Engineer* says: "It is not, we think, too much to say that to Donkin is due the whole credit of proving, by the direct evidence of facts, that heat is converted into work by the steam engine. In this work Mr. Farey was a fellow laborer. Donkin argued that a certain weight of steam passed through the engine per minute. The total heat in that steam as it left the boiler was known. If condensed it would raise the temperature of the cooling water, whose weight was also known, by some number of degrees, x. If, however, heat was converted into work during the passage of the steam through the engine, then, instead of raising the temperature of the water x degrees, it would raise it only through x—y degrees, y being the equivalent of the heat converted into work."

The practical difficulty of actually measuring the water and its temperatures was finally mastered by the ingenious devices employed, the soundness of the theory was fully demonstrated and the system of testing became a standard in the profession.

The general result led to still more penetrating investigations into the details of the steam action in the engine, especially as to condensation in the cylinder and the transmission of heat through the cylinder walls. In 1888 he perfected his glass "revealer" by which he was able to produce diagrams illustrative of the condensation under different conditions.

Some ten years ago Mr. Donkin became interested in the investigation of internal combustion motors, reading a paper upon this subject before the Incorporated Institute of Gas Engineers.

With Professor Kennedy Mr. Donkin made exhaustive tests of twenty-one different types of steam boilers, the collected and published results of which serve as valuable guides in design, construction and working. He introduced the Perret system of forced draft and his firm went extensively into the manufacture of that apparatus.

He was also an investigator in various other directions, sometimes in comparison with others and sometimes alone. Centrifugal fans were the subject of numerous experiments, also the velocities of flow of air through pipes, and in later years he had given much attention to motor cars. He contributed many and always valuable papers to the transactions of the engineering societies, and his writings as a whole are quite voluminous. He was a vice-president of the Institution of Mechanical Engineers, a Watt medallist and Telford and Manby premium and prizeman of the Institution of Civil Engineers, member of the Royal Institution, of several European societies and of the American Society of Mechanical Engineers.

American Workmanship Preferred.

The machinery trust, of Edinburgh, organized about eight years ago, with a capital of £2,000,000, for the special purpose of controlling the manufacture and sale of printing presses in this country, has been gradually extending its influence over this branch of trade and also widening the scope of its operations. The Linotype

Company was the nucleus of the trust, which rapidly acquired nearly all the important plants in Great Britain for the manufacture of printing presses and supplies; also the patent rights for this country on many foreign presses, and in other cases the privilege of making presses of foreign design for this market on condition of paying a fixed amount as royalty. A few years ago the trust went farther afield, obtaining the sole agencies for as many foreign articles as possible; and this concern now has a strong grip on the machinery trade in the United Kingdom, still making a specialty of machines for the printing and publishing business. Some of the leading American presses and other American machinery for the printing trade are manufactured in England by the trust. This branch of the business is in its infancy; its success is by no means certain, as there seems to be much doubt about the quality of the workmanship. A large printing and publishing house in Edinburgh that has long had American presses, folders, stitchers, etc., adding to its American equipment every year, always buys its machines through the trust, but invariably stipulates that such machines must be not only of American design, but also of American manufacture. A member of this firm says that the superior skill of American workmen in fitting machinery of this kind is universally recognized in the trade. Although assured by the trust that the material used in the manufacture in England is precisely the same as that used in the United States, and that the work is done under the general supervision of American foremen, still he and his partners refuse to place confidence in the English-made machines, distrusting especially the workmanship.—*U. S. Government Advertiser.*

[The trouble with such items as the foregoing is that they are apt to be reprinted by the indiscriminating ones and interpreted or accepted as an argument to show that American workmanship is superior to English, whereas this instance shows nothing of the kind. It simply shows that one man preferred the work of a certain American shop to that of a certain other British machine shop, and that is all the ground that it can be said to cover; which is not much.—Ed.]

Textile Fabrics Made of Wood Pulp.

The use of wood pulp as a material, which has had such important results in paper making as well as in other industrial arts, is now being extended to textile manufacture. A process of spinning cellulose tissues into yarn, the patented invention of Gustav Türk, manager of the cellulose works at Walsam on the Rhine, and Dr. Carl Kellner, of Vienna, is being applied by the Patentspinnerei Actiengesellschaft at Altdamm, near Stettin, Germany.

The process by which it is rendered possible to spin the very short fibers of the pulp is a comparatively simple one, besides which there is a distinct advantage in the facility with which dyeing can be effected. Cheapness is the chief end attained, however, for the best wood pulp costs in Germany only one third as much as ordinary cotton and the method of spinning is less expensive than that by which yarns are usually made.

In answer to the objection that the minute length of the cellulose fibers will make the fabric insufficiently strong and that they are too thick, it is contended that for carpets, draperies, furniture covers, etc., coloring, pliability and cheapness are often considerations of greater importance than the strength and thinness of single threads; besides, in the case of wood pulp, the strength of the yarn can easily be increased by submitting it to chemical treatment; and, finally, if such short-fibered yarns are used as wefts in combination with cotton, linen or silk threads, as warp, every single fiber will be tied down at least three times by the warp and therefore the cloth will be almost as strong and durable as pure cotton and linen goods. For the foregoing information we are indebted to Wm. von Brennerberg, care of Ganz & Co., Budapest, Hungary.

Relative Economy of Oil and Coal for Fuel.

Prof. James E. Denton, of Stevens Institute, Hoboken, N. J., made tests, last November and December, under the auspices of the Export Oil and Pipe Line Company, Beaumont, Tex., upon Beaumont crude oil as fuel for raising steam. A report of these tests is contained in a pamphlet sent us by Henry M. McDonald, 100 Broadway, New York. From the results obtained were deduced the following conclusions as to the comparative fuel costs of coal and oil for producing horse-power upon the commonly guaranteed basis of one horse-power per ten square feet of heating surface, and with an average percentage of moisture and ash in the coal: Moisture in coal, 3 per cent.; ash, 17 per cent.; evaporation per pound of wet coal from and at 212 degrees, 8.75 pounds; net evaporation per pound of oil from and at 212 degrees, 14.8 pounds; ratio of oil to coal, $14.8 \div 8.75 = 1.69$; number of barrels of oil equivalent to 2,240 pounds of coal, 4.12; price of coal per 2,240-pound ton, without cartage and cost of ash removal, $3.00; equivalent price of oil per barrel of 42 U. S. gallons, $.73. From this it appears that if oil costs 73 cents a barrel, its economic value is the same as that of coal at the price named, the questions of convenience, etc., being set aside.

The *Clay Worker* says that stone is being abandoned for foundations, as brick is found now to be better in every way.

Arsenic in Brass Casting.

The following is from the specification of a United States patent recently issued to Erwin S. Sperry, Bridgeport, Conn.:

In the casting of alloys containing zinc the oxidation of the molten metal while being poured into the mold is the cause of many imperfections in the castings, the difficulty being so serious as to cause great loss to manufacturers and to render many castings unfit for use. The stream of molten metal in pouring oxidizes with a film-like surface and carries the impurities with it into the mold, which impurities being prevented from rising to the top of the mold by the rapid cooling of the metal, remain in the casting like so much dross. The usual method of attempting to obviate this difficulty is to surround the stream of molten metal, while it is being poured into the mold, with the flame of a liquid hydrocarbon—for example, lard or fish oil—which acts as a reducing agent and reduces the oxid which forms on the surface of the stream of molten metal. The requirement is for a substance that will oxidize when brought in contact with the oxygen of the atmosphere, but will leave an oxid that is not film-forming, it being an essential requirement that this substance shall not be added in sufficient quantity to remain in the metal after it has been poured, but must all, or practically all, oxidize out when the stream of molten metal is exposed, as in pouring, so that the substance used will not change the quality of the alloy to any appreciable extent. Such a material I have found in metallic arsenic.

I am well aware that arsenic has been combined with various other metals in the production of alloys; but its use has been for an entirely different purpose, as it has materially changed the quality of the alloy. It should be noted as an important feature of my invention that just enough arsenic is introduced into the metal to become thoroughly oxidized out in the pouring, so that no arsenic, or practically none, remains in the finished product, it being of course well understood that arsenic in any appreciable quantity entirely changes the quality of an alloy, tending to give it crystalline qualities.

The proper amount of arsenic to be introduced into the mass of molten metal to produce the desired result and entirely oxidize out, so as to leave no traces of arsenic in the alloy, must be determined by experiment for each particular alloy or for the degree of heat at which it is poured. I have found in practice that the amount of metallic arsenic required to produce the desired result varies from 0.001 per cent. to about 0.25 per cent., although the latter amount is only necessary in extreme cases. I have found, for example, that with "high" brass (an alloy consisting of about 63 per cent. of copper and 37 per cent. of zinc) excellent—in fact, practically perfect—results are obtained by using about 0.05 per cent. of arsenic.

Tools for Steep Pitch Square Threads.

BY C. W. HIGGINS.

Within the past few months several articles explaining some of the difficulties incident to the cutting of a coarse pitch square thread, or, to be more accurate, showing the shape of thread made by such tools as are generally used for that purpose, and explaining why they are not square, have been published in the AMERICAN MACHINIST.

Interesting and valuable articles they have been, since second in importance only to knowing how to do a thing is the knowledge of how not to do it; but, after all, they do not tell us what we want to know, *i. e.*, how to cut a coarse pitch thread, or what shape to make a tool which will cut such a thread correctly.

Mr. Rowel proves conclusively at page 225 that the usual form of balanced thread tool will not cut a square thread and the information he gives will, it is evident, apply equally as well to any other form of thread.

A tool of proper shape, the top of which is parallel with and at the same hight as the center line of the screw which is being cut, will make a thread of correct form, but when the lead of the screw is at all fast that style of tool will not cut in a very desirable manner.

Evidently, to cut such a thread as the one to which Mr. Rowel refers—8 inches diameter and 12 inches lead—some other form of tool must be used. The sketches herewith illustrate a method of making such a tool.

Fig. 2 is a section at *a b* of the plan shown in Fig. 1; *B* is a bar of a diameter somewhat smaller than the core of the screw to cut which the tool *T*, Fig. 1, is being made. *C'*, Fig. 1, is a cutter set to bore a diameter equal to the core of the screw, and *C''* is a cutter made of round stock, the edges of which (for making a square thread tool) are at right angles to the axis of the bar and radial to its center; that is, the hole in the bar being central, one half of that part of the cutter which extends beyond the bar is cut away. The top of the thread tool blank *T* having been filed so that when in position for use it will be at right angles with the average inclination of the thread to be cut, it is securely clamped as it will be when in use, the center of its upper surface being level with the center line of the bar, and the front end is trimmed off with cutter *C''*, the lathe having been previously geared to cut the required pitch. The sides of the tool are then formed with cutter *C''*, the tool being fed past the cutter just as it will be fed when cutting the screw. The compound rest, set parallel with the center line of the lathe, is used to locate the tool with respect to the cutter. The tool must occupy the same position relative to the center of the bar that it will be in when finishing the screw; that is to say, it should not be moved by the cross-feed screw after the end is trimmed off.

The width of the tool may be correctly gaged by moving the carriage a proper distance by the lead screw—the width of the tool desired plus the width of the forming cutter—or by means of the compound rest.

An inside tool may be made by a similar process, the forming cutter *C*, Fig. 3, being held in the block *F* which is bolted to the face-plate *E*, the edge of the cutter *c c* being on a radial line from the center,

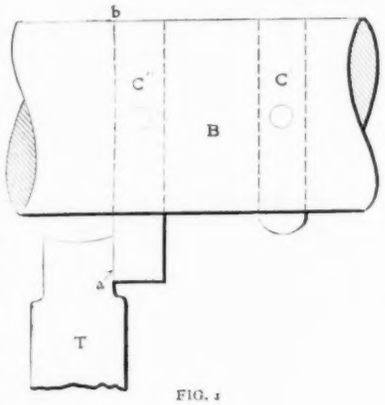


FIG. 1.

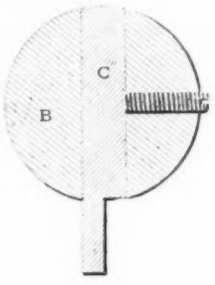


FIG. 2.

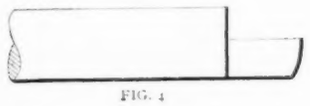


FIG. 4.

FIG. 5.

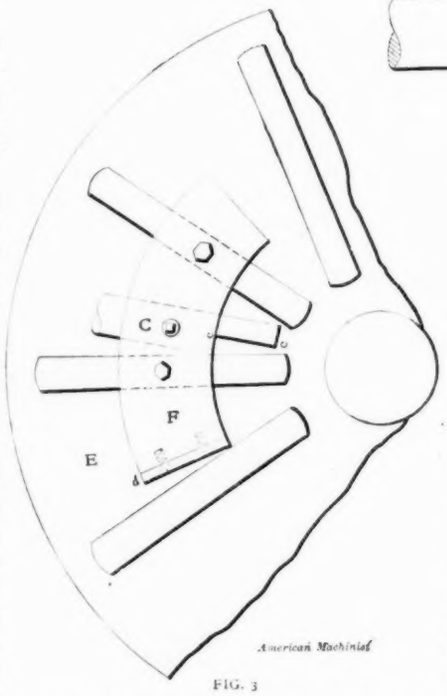


FIG. 3.

MAKING TOOLS FOR STEEP PITCH SQUARE THREADS.

and the block *F* being bored to the largest diameter of the thread to cut which the tool is being made. At *d* is a flat piece of tool steel fastened to the end of the block *F*, which, if bored at the same time as the block and then tempered, will trim the front end of the tool to the correct form.

Owing to the fact, which is well demonstrated in Mr. Rowel's article, that a balanced tool of proper form to cut an inside square thread will be wider at the point than it is at the back, it will be necessary, when the thread to be cut is square, to make the tool somewhat narrow, then, after it has been fed in to the proper depth, it can be moved endwise of the screw by means of the compound rest so as to trim the sides of the thread to shape and make it of proper width, keeping the tool to the full depth of the thread during the process.

For any form of thread which is narrow at the bottom—as, for instance, the Acme—the tool may be made to the proper size.

The angle of the upper surface of a tool made in this manner is not very important. It should be about square with the cut, but it is essential that the edge of the cutter with which the tool is formed should be on a radial line from its center of motion, and that the tool, when *finishing* the thread, be in the same position relative to the center of motion as when it was formed.

If, when making a tool to cut a single thread, the forming cutter be made the size and shape of a section, taken on the plane of its axis, of the thread to be cut, it will trim the tool to size without adjustment, the right-hand side of the cutter forming the left-hand side of the tool during one revolution, and the left side of the cutter the other side during the next revolution, provided the tool has first been roughed so as to leave only a light cut on each side.

Clearance may be cut on a tool in much the same manner as it generally is on a tap, the tool being crowded on to the forming cutter after it has passed the edge, thus leaving but little work to be done with the file. For forming tools for cutting the several threads of a multiple-thread screw at one operation and in various other ways, this method of making thread-cutting tools will be found useful.

Round stock is used for the forming cutters because it is most convenient and when the thread for which the tool is being made is of very rapid lead, as, for instance, the one previously referred to, it will be advisable to make the forming cutter as shown in Figs. 4 and 5. Its position may then be altered to suit each side of the tool, the cutting edge being radial to the center of motion, no matter how it is turned.

Letters From Practical Men.

The Metric System.

Editor American Machinist:

As the American Society of Mechanical Engineers and its committee have in your opinion deserved criticism for what has been done in opposition to pending legislation for the promotion of the use of the metric system in this country, and as I seem to come in for a personal share of it, allow me to reply and to present a few facts in relation to the subject matter, for the information of your readers, so that the case will not be, as you have presented it, entirely one-sided.

As to the status of the metric system in the minds of English-speaking people generally, I commend to your attention the clear and concise expression of it appearing in the editorial columns of the *New York Times* of the 3d ult. I would also refer you to the conclusions reached by Herbert Spencer, a master of logic in all economic questions, in relation to the adaptation of the metric system to the use of the human race in its every-day experiences, which you will find in *Appleton's Popular Science Monthly*, June, 1896. He certainly cannot be charged with partiality to the interests of either science, manufactures or commerce, hence his opinion unfavorable to the use of the metric system, except for scientific or computation purposes, must be considered in the evidence. As presented in your columns, it might lead the inexperienced to think the metric system the only rational one for civilized people to adopt.

At the hearing before the Committee on Coinage, Weights and Measures, held February 15, at which I was present by invitation of the chairman, Mr. Southard, I stated that if the bill as it reads became a law it would make it necessary that all contracts of importance include a clause stating specifically the system of measurement to be accepted. This statement brought about a resolution, while I was present, requesting an opinion on the subject from the Attorney General. If correctly reported, this resulted in an expression of his views, not his legal opinion, which you have included in your editorial.

The views of the Attorney General on the matter of compulsory use of the metric system by the people of the United States are certainly fair and frank, and will coincide with those of all who are reasonable in the matter. Now, in looking at it in the light thus given us, why should any further legislation be necessary? We already have the metric system a legal standard, and if the use of the word "the" in the tenth line of H. R. 2054, making it "the legal standard of weights and measures recognized in the United States," from and after the first day of July, 1902, amended by H. R. 123 to July 1, 1904, means, as Anglo-Saxons understand the definite article "the" to indicate, that the bill was intended by its promoters the only legal standard, as stated in the report of our committee. It might be well for you to include a reprint of the two bills mentioned; they will thus speak for themselves.

While it is true no penalty is attached or included in the measure, the penalty might come later in litigation due to misunderstanding, or the endeavors of ardent metric advocates to enforce the use of the metric system under the wording of the bill, if not definitely specified in advance or in the contract. It was in view of this possibility that I raised the question at the hearing, and I am glad to know that the bill, if passed, will, outside of the admitted compulsory feature in relation to the departments of the government, be an unnecessary legal enactment.

The reasons advanced in your editorial why the passage of the bill is desired, in case of government work, do not appeal to manufacturers to any great extent, for the advantages pointed out will not equal the inconvenience resulting, and it is a question whether representative manufacturers desire to obtain their metric equipment in the way suggested.

In the case of passage of the bill, what becomes of the well established system for bolts and nuts, known the world over as the Sellers or United States standard? This, as you know, was adopted by the Navy Department in 1868, and has since proved in every way desirable to be retained.

If it must be transferred to French metric dimensions, the effect will be to introduce impracticable decimals, if interchangeability now secured is to be maintained. If new sizes and pitches are to be established, then the matter becomes quite another form of complication, with nothing to commend it for either convenience or economy.

It might be of interest to your readers to know which of the representative manufacturers were invited to appear at the hearings of the committee. One firm, of all others—Wm. Sellers & Co., of Philadelphia—having had practical experience for more than forty years in the use of the metric system, were not represented. It would seem as if the result of their experience should have been sought, even though the evidence presented might have been opposed to the convictions of the advocates of it.

Manufacturers of this country do not need to be reminded by such legislation that it is to their interest to use the metric system to increase their foreign trade, or to be instructed by those whose use of it is mainly for computation and scientific purposes. They are quite capable of appreciating advantages of the kind and will adopt whatever is necessary without all this well-meant assistance. The arguments of people who fail to appreciate the value of the inherent qualities which make the main features of the English system of weights and measures so convenient and direct for practical purposes have little influence with them.

In view of the honorary title conferred upon the members of our committee by you, allow me to quote the following paragraph from a letter I wrote the American Metrological Society, dated May 22, 1896, in answer to their inquiry of the 4th of the same month:

"In reply to your question whether I am opposed to the metric system, I would say not at all, if not made compulsory in this country, for I fully appreciate its advantages, which are peculiarly applicable to scientific work and for calculation, but which, as we find in practical service and for ordinary every-day mind, does not carry with it the economy in time and detail, so far as measurements of length are concerned, which is inherent in the English system and its units."

I have not changed my opinion as above expressed, and I am sure all of the members of our committee also quite agree with me.

Finally, if I may further encroach upon your time and space, I would say that your conclusions, stated in italics, are certainly quite in harmony with what I have endeavored here to present, but are not in harmony with the methods adopted by the advocates of the metric system to urge its more rapid introduction in this country. I would submit the following sentence as one to be added: *hence no further legal enactment is necessary to hasten the general adoption of the metric system in this country.*

GEO. M. BOND.

Hartford, Conn.

The Card Index for Business Cards.

Editor American Machinist:

The many articles which have appeared in your columns on the various applications of the card index have certainly shown strong faith in its capabilities, but there is one use I have not seen, for which the system possesses eminent fitness, and that is the standardization of business cards, which at present, as regards size, are in worse confusion than the catalogs you have labored to uniformify.

Business cards at present are preserved by being stuck into saw cuts in a stick, or behind tapes tacked to the wall, or be-

tween the coils of a spring, or in cracks in the ceiling, or behind the window casings—the whole lot tumbling down if any card is searched for.

The regular Library Bureau or other cards are of ample size, and if printed with various suitable headings, and properly notched and punched for the principal fastening devices, would at once call attention to the fact that they were intended for preservation in a card file, and when once there, would have all the advantages of the card index system.

C. S. BEACH.

Device for Tempering With Automatic Alarm.

Editor American Machinist:

While it may not be always necessary to draw the temper of tools used in manufacturing operations and probably would never be necessary if we could be sure of heating them to the best possible temperature for quenching, it is still, and in most cases probably will remain, necessary until much better methods of heating steel become common in workshops.

The accompanying sketches show some apparatus that enables temper to be drawn at lower cost where much of it is to be done and at the same time to do it better than it is usually done—objects which are certainly well worth while.

Fig. 1 shows the arrangement complete. *a* are three small bunsen gas burners with separate stop-cocks at *b*. *c* is an ordinary galvanized-iron pail with a long bail *d* in place of the usual one. This hangs on the bracket *e* which is attached to the wall. Riveted into the bottom of the hook of this bracket *e* is the first link of a chain which supports the perforated pail *f* within *c* and clear of its bottom. The inner pail *f* may also be hooked on the bracket *e* direct, as shown by the dotted lines, to raise it out of pail *c*.

This rig should be located close to the hardening furnace and the quenching bath should be near them also, so that the operator may without moving from his tracks draw pieces from the furnace, quench them in the water or other solution, and before they are entirely cold drop them into the inner pail *f*, the outer pail *c* being filled to within 1½ to 2 inches of the top with lard oil or tallow and heated by the burner to a temperature of about 200 degrees Fahr. After all the pieces to be hardened are in *f*, or when it is full, the burners *a* are turned up, allowing the heat of the oil and all the parts therein to slowly rise to about 400 to 600 degrees Fahr., according to the kind of steel and the service required, when the burners are turned down again and shortly clear out. After the heat has gone down to about the boiling point of water, the pail *f* and contents should be raised to the position *f'* and the hot oil allowed to drain off. To accurately gage the temperature required a so-called "chemical" thermometer may be used. These are simply glass tubes with the mercury bulb at one end and the graduation etched in the tube and have no case. One graduated accurately and up to about 600 degrees Fahr. costs about $2.00. After all the work is in the small pail *f*, this thermometer should be placed with its bulb in or on top of the work.

In my own use of it, as this tempering operation should and usually did extend over two hours or more per lot and other duties had to be attended to meanwhile, I found it almost impossible to keep it in mind sufficiently to watch the thermometer as it should be watched, and as a result was obliged to re-harden several lots by reason of allowing the heat to go too high; this annoyance led me to devise an automatic alarm. This was made by taking a length of about 17 feet of ⅛-inch gas pipe

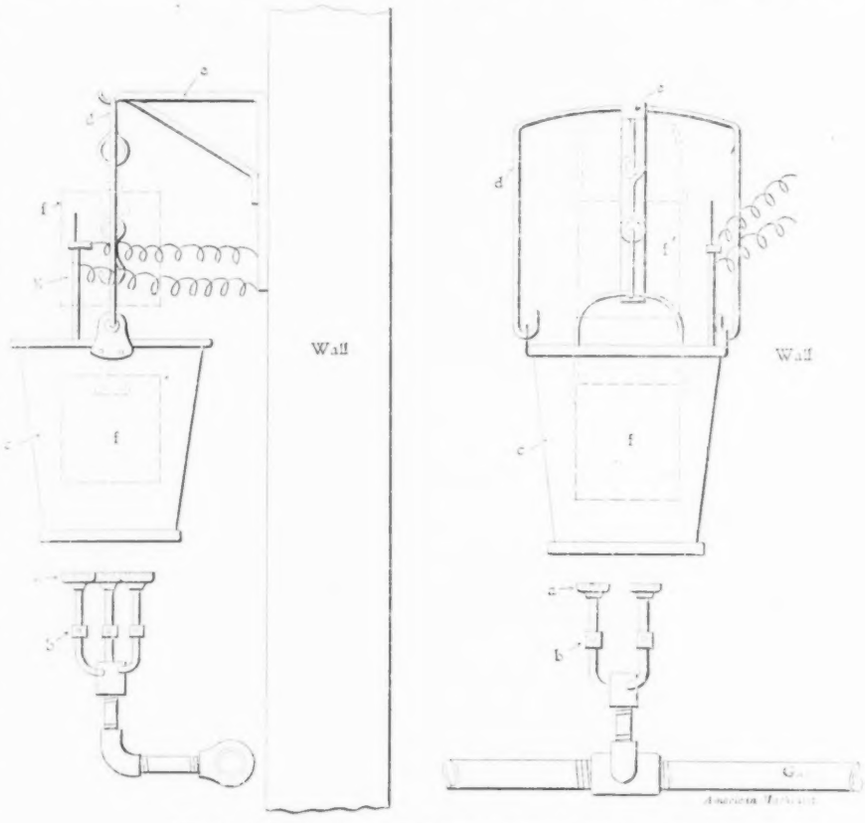


FIG. 1. A TEMPERING DEVICE WITH AUTOMATIC ALARM.

welded tight at one end and coiled by wrapping around an old pulley and then spreading like an open helical spring, so it started in the bottom of pail *c* and ran around and close to the inside to near the top where the end was bent to stand up straight, as shown at *g*. This tube is filled nearly full of mercury, care being taken to work all the air out.

When the temperature in the pail rises the mercury expands, and, rising in the tube *g*, touches and makes contact with the adjustable wire *a*, Fig. 2. One wire from an electric bell is attached to the adjustable wire through the clamp *b* carrying a binding post and is insulated from the coil pipe by the hard rubber collar bush *c* and the small bush *d* near the end of the wire *a* and having a loose fit in the tube *g*. The other wire to the bell is connected to the pipe coil *m* at *e*.

By a few trials and using the thermometer as a standard, the wire *a* may be graduated to the few temperatures most used, when we have a very efficient automatic alarm, and once the work is in the pail and the fire lighted no further thought need be given it until the bell rings, when anyone can reduce and turn out the flame. I was at one time engaged in a place where many thousands of steel pieces were regularly manufactured, all of them being hardened. The work was all similar and less than half the product was tempered after hardening, while the main and cheaper part of the product was not tempered because of the cost. An experienced man by the use of a large hot plate over a furnace did about 400 pieces in 10 hours, while the highest day's work was 500 pieces—and the man was nearly roasted to death, especially in hot weather.

An ordinary half-barrel size caldron kettle, such as farmers and butchers use, and arranged to burn hard coal, was procured. Over the kettle was fitted a galvanized-iron hood with a pipe leading outside, to carry off the smoke and fumes from the hot grease, and with a large door in front. Inside the kettle, which was filled with tallow was a large perforated pail corresponding to *f*, Fig. 1, which held the work. The temperature was regulated by a long stem pitching machine thermometer made by Schaffer & Budenberg, of New

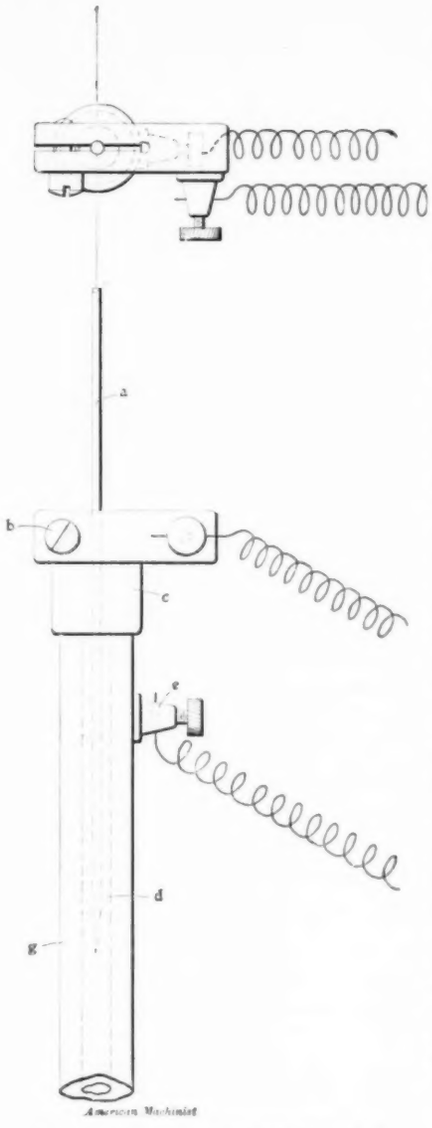


FIG. 2. DETAIL OF TEMPERING DEVICE.

York. With this device one man was not only able to do the full product of about 1,500 pieces in a few hours, but did it in such a superior manner that going back to the old method would not be thought of, even were it not so very slow comparatively. It will be found absolutely necessary to use the hood and pipe for carrying off the smoke of the oil, unless the apparatus is used in the open air.

The hardening and tempering of the tools used in manufacturing operations are among the most important operations through which they pass in the making, yet those operations seem to be least understood generally by those who make tools, and the facilities for hardening and tempering are in most shops precisely the same as were used at the beginning of manufacturing.

I think it perfectly safe to say that between a cutting tool imperfectly hardened and one done in the best possible way the efficiency is as 1 to 5. Some of the manufacturers of such tools as drills, taps and dies, milling cutters, etc., are alive to the necessity for advancement along this line and provide the most efficient and up-to-date hardening devices; but the large majority of them, and nearly all of the toolrooms which make tools for use in their own places, use the "good old" methods.

Toolmakers in general are only just beginning to wake up to the fact that it takes an expert in steel to tell anything but the size of the grain from a fracture; that the size of the grain tells nothing except the degree of the last heat it was raised to; that it is no guide whatever to the quality of the steel; that it is of no importance unless the steel is hardened ready for use, when with a few exceptions, if the crystals are coarse, it shows the hardening heat was too high; that the heat should never be higher than will suffice to reach the required degree of hardness with little or no drawing, and that the drawing when done at all should be done very evenly and slowly, to enable the molecules to settle and relieve the strains of hardening and consequent liability to breakage.

The Foundry Trade School.

Editor American Machinist:

On page 441 you have an article by Mr. Thos. D. West relating to a proposed foundry trade school. I think there is a better plan than to have such schools as are proposed. First, let the government pass a good indenture law binding the apprentice for four years to the foundry trade, covering the branches of green and dry sand and loam molding, mixing and melting iron, mixing core sand and making cores. Have the same bonds protect the apprentice by binding the proprietor to offer every opportunity to the apprentice that the shop affords to perfect him in the acquisition of his trade. By this method a proprietor will not be afraid to push his apprentice to his highest usefulness, as he will not fear the loss of the apprentice. As it is now, as soon as the majority of our young men are able to make one piece there is a desire on their part to make money, and they seek other shops at an advance, so that the party a young man starts with seldom gets money out of him before he is gone.

Then, again, if only those who held government licenses could draw molder's pay it would go a good way towards filling our country with such men as John Peattie, page 439. It is impossible to place such men where they cannot work out.

If you are going to do anything in the line mentioned by Mr. West, let it be in the way of a technical institute, open only to such as have served a prescribed apprenticeship or worked the four years. You will find that not many will be dazzled by the additional information, and those who are will find some way to avail themselves of the advantage; while in the method suggested by Mr. West not 10 per cent. of the student molders would ever be heard from. Colleges are all right to refit and finish up a mechanical investigator or a student, but are not much good in building from the bottom, unless the subject is particularly adapted to the calling, and then it would be better for him to get shop-wise in actual shop practice before his college course.

In all other lines when a young man determines on a college course he gets it, and molders are just as sterling a class of men to secure their wishes as any others. Give us such a school as you mention, but make four years' work in the shop on floor and bench the leading requisite to admittance, and you will confer a favor on many a deserving poor boy who wishes to pursue his chosen calling and command a social position in so doing.

P. McNAUGHTON.

The Scrapping of the Big Bethlehem Hammer.

Editor American Machinist:

The AMERICAN MACHINIST is the first paper I have noticed which has mentioned the scrapping of the Bethlehem hammer without lauding the courage and enterprise of the Bethlehem Steel Works in scrapping so costly a tool.

I write because I am very curious to know whether the hammer was taken out because the forging press is a more efficient tool or whether this particular hammer was a "bad egg." The Midvale Steel Works have had Whitworth hydraulic presses in use about a year, but when I passed there two weeks ago I plainly heard No. 10, as they call their big steam hammer. This hammer is still, as in past years, in constant use. While not as big as the Bethlehem hammer, the Midvale tool is nearly as powerful, being double acting, and is the better tool, having turned out vastly more work.

I used to be on the Midvale pay-roll, and, while there, used to talk to Bethlehem machinists who would come down to work in Philadelphia. More than one has told me that the Bethlehem hammer was a "white elephant," and that it kept a big lathe and the repair gang busy to keep it supplied with new rods.

It often happens that a hammer-man has a flat job right in the center of the hammer head and rod. When this is so, he can strike a fair blow; and when it isn't so—the usual thing—he must strike a foul blow. I have been informed that the Bethlehem hammer was a "bad egg" because it could not strike foul blows and keep striking them.

The Midvale hammer was designed by Mr. F. J. Taylor, and built at Midvale. The anvil principle is, so to speak, embodied in the design. The anvil proper acts as an anvil, and the hammer acts as a hammer. In the Bethlehem hammer, the cylinder and housings, being rigid, acted partly as an anvil, and the hammer

rods soon broke. The Midvale hammer is not rigid; the hammer head is supported by slides, and when striking foul blows the cylinder and housings have some movement. The maximum horizontal movement of the cylinder is 6 inches. The housings are built up of heavy cast-iron slabs and wrought braces. I think that among Midvale "spares" there is a rod for No. 10, but they seldom have to make a new one.

I would like to know if the hearsay regarding the Bethlehem hammer is true, and hope you can give us a good detailed description of the Midvale hammer.

I don't know any more of the Midvale hammer than I have told. They don't want machinists fooling around the hammer shop, and I came near getting fired for finding out this much.

Some years ago you told us of Taylor's system of belting at Midvale, and later of his differential piece-work system, which scheme is now in the scrap heap at Midvale. FERD. WERTHEIM.

Chicago, Ill.

Spiral Gears.

Editor American Machinist:

At page 1337, Vol. 24, Mr. Randol makes some statements about spiral gears which do not seem to agree very well with general practice. Mr. Ferris, at page 157 of the present volume, gives a graphical method of determining the efficiency of spiral gears which I thought would sufficiently controvert some of Mr. Randol's statements, but it seems more practical facts are required to convince him. I want to say, however, that I consider his method of calculating spiral gears about the simplest and best I have ever seen, and he is entitled to full credit for it. If I was required to turn and cut a pair of gears where either the spiral or bevel form would answer, I would surely choose the spiral form, because they are so much easier to produce; but I would not expect them to transmit the same power, except at an increase of frictional loss.

The statements to which I would take particular exception are: "Such gears [spiral] may be used to take the place of bevel gears and are in every way vastly preferable thereto," etc.; and "The spiral toothed gear has the vast advantage of a much higher speed of the rubbing surfaces, and so will transmit the same load with much less crushing effect on the gear tooth faces, and hence runs the easier of the two and is the more durable." By spiral gears I understand the usual screw or worm form of gear, and not spur gears with the teeth cut spirally. The only real differences between spiral and worm gears are in the form of the teeth and the length of face, and in both the spiral form suffers in the comparison. The convex form of tooth as cut by involute cutters permits of but point contact on each tooth, while the length, or rather shortness, of face, often reduces the number of teeth in simultaneous contact.

In regard to the first statement I would ask Mr. Randol to take a pair of spirals with a speed ratio of 6 or 8 to 1 and an angle of 30 degrees or less, and attempt to use the slow gear as the driver. The efficiency will be readily shown by this test, particularly if the driven shaft be required to overcome some slight friction. It is very common to use bevel gears in this way, without any trouble and certainly very little friction.

The first part of the second statement seems to be sufficient answer to itself. The friction loss is conceded to be about directly proportional to the speed of the rubbing surfaces, and this speed is certainly much greater in spiral than in bevel or spur gearing of equal diameter, while the pressure on the tooth faces is practically the same. This would make the latter part of the statement read, "runs the harder of the two and is the less durable," which certainly is the fact.

I want to add a few incidents with which I had some experience, which will show where spiral gears should not be used or attempted. In the first case a pair of 45-degree spirals of equal diameter (4 inches) were used for an elevating device on a wood-working machine, the driver being rotated by a 10-inch hand wheel and the driven gear turning a shaft about 1½ inches diameter on which two worms were fastened to engage two internally threaded worm wheels which did the elevating. There was generally a little fitting to do on the driven shaft, and our test was to be able to turn it easily by gripping with both hands; if this could not be done, it certainly couldn't be turned through the spirals with the 10-inch hand wheel on the driver shaft. The gears were made of cast iron and any undue friction would cause them to seize and cut when further movement was impossible. Later we adopted the expedient of filing the faces of the teeth somewhat flat to give a better contact and using a very heavy oil. The second case was a crank-hanger jig and the design called for a pair of 2½-inch 45-degree spirals operated with a 12-inch hand-wheel to tighten the clamping bush. These gears were of machine steel and case-hardened; they worked very nicely until the bushing came in contact with the hanger, when the gears would jam and stick, making it impossible to tighten enough to hold the hanger. The thread on the clamping screw was of fine pitch and had previously been used with a wrench to perform the same function, without any trouble. The jig was intended to expedite the work, and the spirals were chosen because they lent themselves admirably to the design of the jig, but they had to be abandoned and were never used.

The moral of this experience seems to be that spiral gears should not be expected to do too much; the pressure on the teeth should not be greater than the material will bear without deterioration of the integrity of the surfaces in contact, remembering that the contact is about point contact. It is in this matter of contact that spiral gears are weak, as we have here the condition of high bearing speed, very small bearing surface and pressure according to the load. I would recommend Mr. Randol to use a hand-wheel to try some of these spirals with different loads; or, better still, use pulleys with cords and weights and make a few tests for efficiency. The data would be very interesting, particularly the pressure a tooth will bear without injury, and I think Mr. Randol would then not again rashly advise the AMERICAN MACHINIST readers to abandon bevel gears.

I lately saw some bevel gears which were produced at but a fraction of the usual cost, and which ran at a high speed with practically no noise. They were cast gears, but the teeth in the iron patterns were planed theoretically correct, and special care was used in the foundry, so that very little work was required to produce a gear far better than is usually made with a milling cutter. I have no doubt that before long most bevel and miter gears will be made in this way, as they are peculiarly adapted to be drawn from the mold without rapping and consequent distortion; and cutting bevel gears without proper tools is generally an abomination and makeshift at best. GEO. J. MEYER.

Making Drawings and Patterns for Screw Propellers.

Editor American Machinist:

Most patternmakers who are familiar with up-to-date methods in marine work are sorely tried at times at the colossal nerve displayed by back-numbered marine draftsmen whose drawings of screw propellers invariably show ignorance of modern methods, as well as an utter disregard of the time wasted in presenting views in projection that mean little and are of no help whatever to patternmaker or molder in shaping the blades correctly and with dispatch.

Another pet way that is considered an improvement on the projection method is what might be called the text-book encyclopedic or drawing-school mode and consists of showing several cross-sections of the blade with the resultant pitch angles, the object being, as nearly as I have been able to find out, to guide the patternmaker in making the blade fit as many templets as there are angles shown on the working side, and again as many for the back. The inadaptability of this method to the work is very evident from the fact that, if the segments be glued relatively correct, it is unnecessary to use any templets on the working side, or, as I propose to show, on the reverse side of the blade. It will hence readily be seen that this

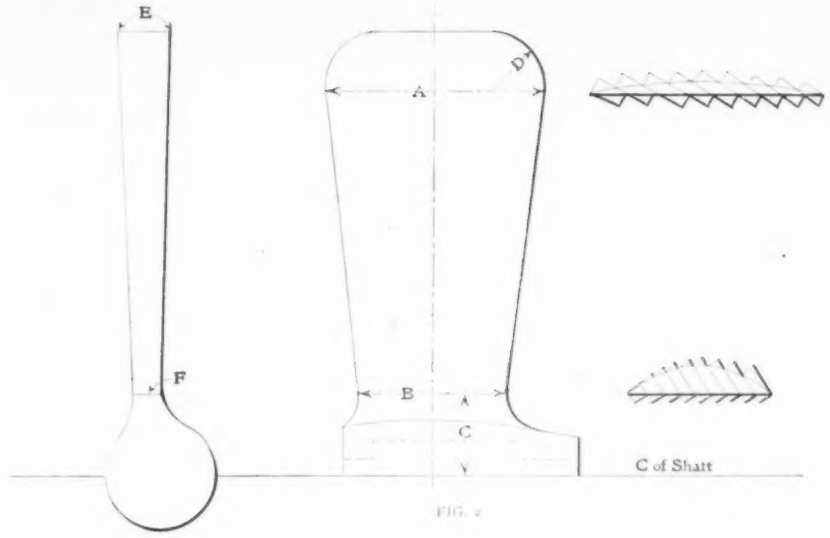


FIG. 1 FIG. 2

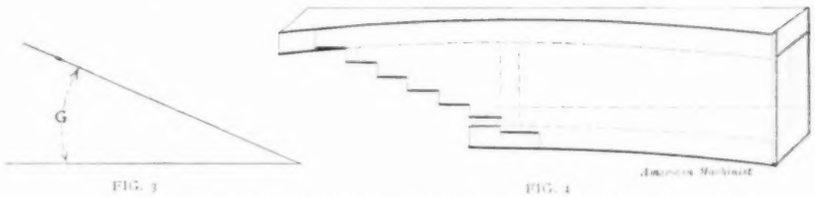


FIG. 3 FIG. 4

SCREW PROPELLER, DRAWING AND GLUING-UP BOARD.

method is as useless as the first. It is, in fact, about on a par with the practice of inexperienced patternmakers who attempt to make perfectly balanced castings of two, three or four-bladed propellers of small size, by paring the pattern so that the blades balance, losing sight of the fact that as the specific gravity of the lumber in the segments varies, so does the chance for a balanced casting. This, to say the least, gives a decidedly slim chance, as experience shows that no two segments of like dimensions will weigh the same, not even when cut from the same plank.

In the drafting room of a certain naval architect and marine engineer in New York, who is famous the world over as the designer of some of the fastest craft ever built, it is the unswerving rule that, when making drawings for screw propellers, no views are to be shown in projection. Such drawings are treated like others, advantage being taken of all the short cuts possible, aided by written matter wherever needed.

This method, which is nothing more or less than what is known as a "patternmaker's drawing," is as follows:

The pitch and diameter are given as part of the title. One view shows the blade as it would appear if flattened out, as in Fig. 2, with all the necessary dimensions such as *A*, *B*, *C*, and *D*. At the right two cross-sections of the blade are shown—one at the greatest width and the other at the top of the hub fillet, or at the least width and greatest thickness. These two sections show the number of segments required for the pattern, but they could with safety be left off the drawing, for strictly speaking, they do not aid materially in the development, as does the view of a segment, Fig. 1, with an accompanying table of figures, not given. Here we have all the necessary data, such as the thickness and width at *E* and *F* of each segment, which enables the patternmaker to get out all his stock, each segment differing from the others as the thickness varies in longitudinal section. In this way proper sizes and shapes are insured without templets for the back of blades, as, after gluing up, it is only necessary to cut the surplus stock away until the intersections formed by the glue joints show, just as is done on the working side. If I make myself clear, I think that any mechanic will admit that this plan is a vast improvement over the old and not always sure method of using a half-dozen or so templets for this purpose, which incidentally consumes valuable time in large, juicy chunks and rarely results satisfactorily.

As to the working side of blade, the old way was to scratch gage each segment with lines on the ends and attempt to glue to them. This plan, with the best luck possible, was an inaccurate and slipshod way, as the old-fashioned "pitch-board" only scribed the lines on the ends as a guide, and after they were worked to, all accuracy was lost, whereas with a "gluing up" board, such as shown in Fig. 4, it is impossible to do other than good work, if proper regard is paid to planing the segments to a thickness so that their sum total is correct.

With the "gluing up" board in use, a perfect relation of the segments is assured. It is usually made of thin stock that will bend to the circle of the outside diameter and is cut into strips to suit the segment thickness. The angle of the points is given at *G*, Fig. 3.

When making propellers of a size that must be swept up in loam, the view and table of segment dimensions would be manifestly superfluous, and an increased number of blade cross-sections must be shown, as guides for the patternmaker in band sawing and for the molder in building up and forming his "cake" or sand pattern. A molder's pitch-board is also necessary to guide the sweep, which must be at a sufficient distance from the spindle to insure a fair margin for parting the joint of the mold.

Perhaps it would be well to state here that this method works equally well on propellers of all kinds, and I think a trial will convince anybody that it is the real thing as a time-saver. Such a trial will prove conclusively that, though the two methods first described are still used by many draftsmen, they are thoroughly out of date. In this connection I notice that, in an editorial commenting on X. Y. Z.'s letter on correspondence schools, at page 138, Vol. 24, ye editor expresses a tacit approval of drafting "screw propellers and the like" in projection. While I do not desire to lock horns with him, it would gratify me, and perhaps some other readers of the AMERICAN MACHINIST, if the editor would take his turn at the bat and justify his position by scoring a hit, even if it is only a "scratch" on this interesting subject. OLD BOB.

[Neither have we any desire to lock horns with one who knows so much more about the subject than we do.—Ed.]

A Remarkable Case of Wear in a Ball Bearing.

Editor American Machinist:

I send you herewith two balls taken from a ball bearing that has been in use about nine months. Last June I made a ball thrust bearing for the step of a 75 horse-power horizontal water wheel, putting the bearing on the main shaft about 12 feet from the wheel. The bearing was of the common three-point construction, and it had eighteen 1-inch balls in the race.

On examining it recently I found the balls to be only about 9-16 inch (.564) in diameter, they having worn down and kept their shape as perfectly as one could wish. They do not vary more than .0005 from one another or from perfect roundness. They were made by the American Ball & Bicycle Company, of Cleveland, O. No dust or grit could get to them and they were kept well oiled. I would like to know if any of your readers have had a like experience with ball bearings.

Ithaca, N. Y. CLAYTON L. STANTON.

[The balls are covered with a checker-work of lines, looking like incipient cracks, but the surface is good and the balls are about perfect in shape.—Ed.]

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The Metric System.

Elsewhere in this issue we publish a second letter from Geo. M. Bond, of the American Society of Mechanical Engineers committee, on the metric system. It is well worth reading as coming from a man who has given special study to the subject. We think, however, that the opinion of the Attorney General of the United States must be taken as authoritative as regards the import and effect of the proposed legislation, and that there is therefore no use in discussing the meaning of the definite article "the." The Attorney General's opinion means, if it means anything, that Congress not only is not going to pass laws making the use of the metric system compulsory in private transactions, but that it cannot pass such laws with any chance whatever of having them enforced. It is only because we have an abiding faith that the people of America cannot by a law of Congress, or by any other means, be compelled to use the metric system that we think it useless and perhaps a little worse than useless for the American Society of Mechanical Engineers to maintain a standing committee for the sole purpose of opposing such legislation. We have not and do not intend to criticise the action of the committee in doing what it was appointed to do. Our point is that there is nothing for it to do and cannot be.

The committee is composed of men who represent the very best and highest engineering talent in this country; we regard it as a shining example of "good men gone wrong," not of course in the bad sense, but in the sense that would apply were one to take a columbiad to kill a mouse—a non-existant, imaginary mouse.

Mr. Bond refers us to certain published opinions about the metric system. They are already familiar to us, and we believe them to be utterly worthless. We do not believe that a logician can, by his logic, prove one thing or the other regarding the merits of the metric system, though he be a greater than Herbert Spencer.

For the past fourteen years the writer has been using every opportunity that presented itself to inquire of men who were or had been using both systems what they thought of the metric system, and whether they found its use more difficult or more bothersome than the English system. Very many such persons have been questioned about it, and with very few exceptions they have said in effect that the objections to the metric system were largely visionary; that a little familiarity with it made its use just as convenient as (some said much more so than) the English system. It is such logic and such evidence that does and will count for something; and in our opinion no other will.

If a foreign user of machinery or of tools or gages wants such things made in this country, in accordance with the metric system, he asks for quotations on what he wants. No maker is obliged to quote him, however, unless he desires to do so, and if he does quote he will certainly make prices that he expects will recompense him for whatever expense and trouble may be foreseen or calculated upon in carrying out the contract. The Pratt & Whitney catalog shows that that company does this regularly and that the department of which Mr. Bond has charge does the work. At Paris that company exhibited a set of screw-thread standards made to the "International (Metric) Standard" and solicited orders for similar sets. This was, we believe, the first complete set of standard gages made for that thread and the price at which they were quoted was about $450. Now the company with which Mr. Bond is himself so prominently connected did not make these gages and offer them for sale because of any theories as to the superiority or inferiority of one or the other system of measurement, but simply because they believed that it was "good business," *i. e.*, that it would probably pay to do so. The point we make is that if the United States Government becomes a buyer of machinery and tools made to the metric system, no one will submit bids to supply such machinery and tools unless he wants to, and he won't want to, except at prices that he believes will afford a profit on the transaction. We therefore utterly fail to see where the hardship to a manufacturer comes in, or why a manufacturer should permit himself to be in the least disturbed by the prospect of being asked to bid on such work.

If the proposed legislation is passed, the manufacturer will *if he chooses* do for the United States Government precisely what many American manufacturers (including the Pratt & Whitney Company) are now regularly doing for their foreign customers at a profit. We are entirely unable to discover any prospect of hardship to the manufacturer in that.

Some of those who discuss this matter seem to think that the entire equipment of a machine shop will have to be changed over to conform to the new system, but of course grinders, lathes, planers, millers, etc., will produce work to the metric measurements as well as to any other and no change need be made in them in order to do so.

No law of Congress prescribes the present use of the Sellers thread by the Navy Department. It is used because of an official "regulation" or order. We feel very confident that the same thread will be used after the proposed law is enacted, if it is enacted, though the dimensions may be stated in metric terms. It is to be remembered that the proposed law does not specify the sizes of piston rods nor the diameter of cylinders or things of that kind. Designers of government work will go on making them the sizes which they consider best, *all things considered*, just as they do now, and if the dimensions are stated in metric terms, that, as we under-

stand it, will be a full compliance with the law. If a piston rod that is 3 inches diameter breaks and must be replaced, a new one can be made and the specifications may call for its diameter to be 76.2 millimeters, which is the practical equivalent of 3 inches (within 0.00004 inch), and whether the man who turns it or grinds it aims at the one size or the other will make no difference.

Mr. Bond nor any other opponent of the metric system can possibly feel any more interest in the welfare of American manufacturers that we do. Simply he sees, or thinks he sees, a menace to their welfare where we can see none at all, and that is really about all the difference between us on this subject.

The Steamfitters' Case Again.

A little short of two years ago—in No. 30, Vol. 23—we expatiated at some length upon the "Right of Contract in Organizations" as illuminated by a labor decision in the courts at the time. It was due to a contention between two unions of steamfitters and turned upon the question whether a body of men have a right to regulate the employment of other men by striking and threatening to do so. The Appellate Division of the New York Supreme Court held that they have such a right. This decision was to be regarded as an important precedent for the freedom of action of labor unions, and also for ulterior considerations. But it yet lacked the sanction of the highest State judicial authority. Since then the case has been going on through the factory of justice until it has now emerged from the finishing department—the Court of Appeals. That body, by a vote of four to three, have concluded to leave it in practically the same shape in which it reached them, and their decision establishes it as the law of the State of New York until the next time a case involving the question comes before them. It is to be observed, however, that this august tribunal, like the United States Supreme Court in the great Insular cases, said in the plainest way that it is possible for a court with an odd number of judges to say that it really didn't know what the law on the subject was. However, the cause of public justice is much better served by leaving these many men free to speak their many minds than if they were locked up and told that they must come to a unanimous agreement before they could have dinner.

In the case just decided there were two associations of steam-fitters—the National Protective and the Enterprise. Some of the National Protective men worked for lower wages than required by the members of the Enterprise. The latter, through its walking delegates, insisted that contractors employing National men discharge them and fill their places with Enterprise members. To enforce this demand strikes were threatened and instituted, and legal proceedings ensued.

Chief Justice Parker, who wrote the Court of Appeals' opinion, holds that "workingmen have the right to organize for the purpose of securing higher wages, shorter hours of labor or improving their relations with their employers. They have the right to strike provided the object is not to gratify malice or inflict injury upon others, but to secure better terms of employment for themselves. A peaceful and orderly strike is not a violation of law. A body of men, having organized for purposes deemed beneficial to themselves, have the right, when they feel it is detrimental to the interest of their organization, to refuse to work. Their reasons may seem inadequate to others, but if it seems to be in their interest as members of an organization to refuse longer to work it is their legal right to do so." The court thus affirms in plain words that what one man of his own purpose, in good faith, may legally do in regard to relinquishing of his employment does not become an illegal conspiracy because a number of men agree to do the same conjointly. An additional and important, though a seemingly obvious point is passed upon, namely that "if the conduct of the members of an organization is legal in itself it does not become illegal because the organization directs one of its members to state the reason for its conduct. . . . A labor organization is endowed with precisely the same legal right as is an individual to threaten to do that which it may lawfully do."

In some newspaper comment which this decision has called forth it is treated as allowing "the right of conspiracy." Such a phrase is liable to be interpreted by the conservative and superficial mind as meaning that the floodgates are flung wide open to revolution and all unrighteousness. It really means little or nothing of the kind. At most it denotes a sweeping away of that limbo of cases where it is unlawful for several men concurrently to do a certain thing which any one of them had a right to do from independent choice.

Taken all in all, the decision seems to fix the law in New York State as allowing labor organizations a pretty free hand in employing their customary methods of coercion, barring malicious motives or a breach of the peace.

Building of Naval Vessels in Government Yards.

The chief officers of the International Association of Machinists and of the Brotherhood of Boilermakers and Iron Shipbuilders appeared before the House Committee on Naval Affairs recently to make an argument for the construction of naval vessels in the government yards rather than by private contract. They claimed that vessels could be built in the navy yards at considerably less cost than the contract prices of private builders, but were not prepared to give particulars or figures to sustain this contention.

In connection with this affair the *Machinists' Monthly Journal* comments upon the fact that two members of the International Association of Machinists, employed by the Norfolk Navy Yard, and who were appointed on a committee to go to Washington in connection with this effort to have naval vessels built in the government yards, were refused leave of absence by the Norfolk Navy Yard authorities on the ground that the President's order prohibiting government employees from making any effort to influence legislation on their behalf would be violated by the proposed appearance of these machinists for such a purpose. It is, we understand, the purpose of the machinists' organization to fight such an interpretation of the rule or if necessary to fight for the rescinding of the rule itself.

Agitation for Higher Wages—Effect of Combinations Upon Wages.

With the approach of spring there is the usual increased agitation among workmen everywhere and in all lines of work for increased wages or otherwise better terms of employment, and especially is this noticeable among the woolen mills of Rhode Island, where there has been more or less disturbance for some time. It is announced that an increase of 25 per cent. in wages and an eight-hour day had been granted to the members of the Structural Iron & Bridge Workers' Union in the Pittsburgh district, the principal employers of these men being the American Bridge Company. In Paterson, N. J., weavers have been granted increased wages and the Reading Iron Company has advanced the wages of puddlers from $4 to $4.25 per ton. By agreement between the Iron Molders' Union and the Stove Founders' Defence Association an increase in wages of 5 per cent. has been granted. The men had asked 10, and the new rate is a compromise.

Bearing on this matter of the efforts for better terms of employment are some expressions of opinion brought out by Labor Commissioner O'Donnell of Minneapolis. He addressed letters to a large number of wage earners, asking them their views as to the effect upon the interests of labor of the great mergers or so-called trusts. The majority of replies stated that in the writers' opinions these larger corporations were beneficial to wage earners; that the unions of workmen could deal with them in a more satisfactory way and that employment was more certain and wages higher than where a contest had to be made with each individual employer.

Secret Rates for Freight Shipments.

Manufacturers are largely interested in the fight that is now going on regarding secret rates on freight shipments by railroads. Enlargement of the powers of the

Inter-State Commerce Commission is asked for contending against this evil, and it is reported that very many of the officials of the leading railroads of the country are in favor of taking such steps as will effectually prevent the granting of secret or differential rates to shippers of some classes of goods, these officials admitting that the practice has grown to an evil which affects them injuriously as well as the smaller shippers. There can be no doubt that a great deal of harm has resulted from this practice of making secret rates. Particularly have small shippers been placed at a disadvantage as against large ones by it, and it would seem as though a prime necessity of business and for the maintenance of the possibility of competition upon fair terms would demand that the use of commercial highways should be upon the same terms for everybody. Some evils of the present situation, however, it would seem impossible to do away with by the methods proposed. For instance, taking the anthracite coal business. We have seen lately the presidents of several railroads taking part in a conference regarding the wages of anthracite coal miners. This means that the presidents of these roads are interested in the companies which mine anthracite coal, and it is well understood that the practice of anthracite coal carrying roads is, not to make secret rates, it is true, but simply to make such high rates for carrying anthracite coal as to make the mere mining or production of such coal an unprofitable business, or at least a very poor paying business. Though the mines owned by the railroads ship their coal to market at the same high rates, the money made in the transaction, instead of being made by the mining company, is made by the coal-carrying railroad, but its ultimate destination is exactly the same pockets, or the pockets of the same individuals. It remains to be seen, too, how effective the laws or rules of the Inter-State Commerce Commission can be made in the matter of secret rates where the officials of a railroad may be interested in a manufacturing plant.

Instances are very well known wherein certain manufacturers of steel, for instance, have been placed at a great disadvantage as compared with competitors, by reason of secret rates having been given the latter, and in at least one case we know of, a certain steel company recovered from a prominent railroad over $400,000, of which the steel company had been defrauded in this way; the case having been settled out of court. No one knows how many manufacturers have been injured or ruined by similar practices without finding out what was hurting them or where proof of injury in that manner could not be secured.

Those Cheap Tools.

Some time ago we referred to a letter published in the *Leeds* (England) *Mercury*, which letter spoke of an offer received by a Leeds engineering works of American-built machine tools at greatly reduced prices. We expressed some doubt as to the accuracy of the story, and have received a letter from a friend in Manchester saying, "We don't allow strangers to make sarcastic remarks about the *Leeds Mercury*. It has a hundred years of high and honorable tradition, and it is not in the habit of printing fishy stories. For proof I enclose a letter which we received." . . .

The letter referred to is from Max Kasper, a machinery dealer in Dusseldorf, offering Garvin machine tools belonging to the Deutsche-Garvin Company, of Berlin. Another correspondent writes us that the *Leeds Mercury* information is correct, and that the firm in question is De Fries & Co., of Berlin and Dusseldorf. Of course, we intended no disrespect to the venerable and honorable journal referred to, and the letter enclosed by our Manchester correspondent proves its sincerity. Still, there are some features of the story that we do not understand, though probably it is not worth investigating.

Technical Publications.

"Engineering Practice and Theory for Steam Engineers." Second edition. By W. H. Wakeman, 184 5x7½-inch pages with numerous illustrations. Published by the author, New Haven, Conn. Price, $1.00.

This book was noticed in our columns when it first appeared, and we are glad to notice the appearance of the second edition. It contains a great deal of condensed and useful information for those in charge of steam power plants.

"Bricklaying." By O. B. Maginnis. 85 6x9-inch pages, with 148 illustrations. Published by the author at 310 West 128th street, New York. Price not stated.

Beginning with a description of bricklaying tools and of the simplest work, this book goes on to explain the laying out of work, measuring, leveling, mixing concretes and mortars, bonding of various kinds and for different thicknesses of walls, building arches, lintels, piers, chimneys, etc., anchoring, bracing and furring. The second part treats of shoring, needling, underpinning and sheet piling. The whole work is strictly practical and useful.

A friend sends in a newspaper account of the invention of a Chicago man, who, it is claimed, has discovered perpetual motion, which consists simply in the erection of an immense chimney in which it seems there is a natural downward draft—that is, a flow of air from the upper cold currents to the lower warm currents. This current is obstructed by turbine wheels or windmills which furnish the power, and we have before us a newspaper picture of such a chimney that is to be erected at St. Louis and is to develop power in that way. Those who have had the usual experience with chimneys and in deciding which direction the "natural draft" moves will, we think, be a little skeptical regarding the amount of power which can be developed by this expedient.

At the hall of the Franklin Institute, of Philadelphia, Thursday evening, April 10, Mr. Frederick W. Taylor will speak before the mechanical and engineering section on the subject of shop management. We understand that anyone interested in this subject is at liberty to attend the meeting.

A call has been issued for a national reciprocity convention to be held in Chicago, April 10, at the Grand Pacific Hotel. All who are interested in this question, and especially manufacturers, are invited. The call is issued under the auspices of the Western Reciprocity League, of which Gov. W. E. Stanley is president and A. B. Hulit, secretary.

A flywheel recently burst at the works of the Detrick & Harvey Machine Company, Baltimore, Md., and one man was killed. We are glad to say that the damage done to the plant was not such as to put it long out of service, for it was crowded with orders. Efforts were made to repair the injury at once and the shop is probably again running as we go to press.

Personal.

C. H. Buckley, formerly of Bethlehem, Pa., is now assistant superintendent of the William Tod Company, Youngstown, O.

Charles Churchill, of London, is on the way to America for his annual visit and will be here for some time, with headquarters during his stay at the office of the American Gas Furnace Company, 23 John street.

J. D. Hurley, formerly vice-president and general manager of the Standard Pneumatic Tool Company, now owned and controlled by the Chicago Pneumatic Tool Company, has been appointed manager of the latter, with headquarters at Chicago.

Anthony Victorin, formerly of Watertown, but who for some time past has been in the Bureau of Ordnance of the Army at Washington, has been transferred to the Watertown Arsenal, where he will have charge of the construction of the 16-inch disappearing gun carriage which he has designed.

A. Otto Diechmann, formerly of Berlin, has removed his family to New York, his address at present being 59 East Fortieth street. Mr. Diechmann says that he has closed up his affairs in Berlin, but has not yet decided what he will do here. He has been and is at present visiting among his many friends in American machinery circles.

Obituary.

George W. Hickey, engineer and chief machinist at the Lardner's Point pumping station, Philadelphia, died April 6, sixty-six years old. He was a native of Philadelphia and had worked some years as a machinist before the Civil War, in which he served until the end. He had been connected with the water department thirty years.

Hugh H. Scott, a machinist and engineer, sent to Andersen, S. C., to erect an engine by the Westinghouse-Church-Kerr Company, was accidentally killed a few days ago. Steam was turned on for the first time and Scott was watching the engine. He stepped on the base to oil a bearing, when his foot slipped and he fell into the flywheel. Mr. Scott's home was in Brooklyn.

James Jolly, of the firm of J. & W. Jolly, Holyoke, Mass., died March 27, fifty-five years old. Mr. Jolly was born in Scotland, where he learned the machinist's trade. During the 70's he was head machinist in various mills in the neighborhood of Holyoke, and about twenty years ago with his brother he started the machine shop, which has secured a high local standing.

W. Riley Brown, president of the Columbus Iron Works and of the Southern Plow Company, Columbus, Ga., died March 28, eighty years old. Mr. Brown had lived in Georgia all his life. He learned the molding trade and was first connected with the firm of Wildman & Craig. The Columbus Iron Works was organized in 1855, he being its superintendent and in 1860 president. The works were run on war material throughout the Civil War, and after that on machinery of various kinds, the specialties being ice machines and plows.

Commercial Review.

NEW YORK, Monday, April 7.

STEAM AND ELECTRIC POWER AND OTHER MACHINERY.

The tone of the engine market continues emphatically optimistic. Demand is steady and some concerns are doing distinctly more business than they did a year ago. There is an upward tendency in values—in fact, enough sellers report that they are getting higher prices for their goods to constitute a noteworthy feature of the market. This is partly due to the greater cost of materials, especially to the results of the pig-iron famine, but it is also influenced by increases in wages. The latter is an interesting point. Comparatively little has been said of late about wage advances being made in the machinery building line, and it is gratifying if such a movement as these reports would indicate is taking place. In several other lines of industry wage increases have lately been announced; for instance, a 5 per cent. raise to stove-plate and furnace molders was decided upon recently at a conference in Chicago between the National Stove Manufacturers' Defence Association and labor men.

There is a very good amount of work moving in isolated plant installations locally, some of it pretty large. The order for the engines of the new Stock Exchange building has gone, it is reported, to the Ball & Wood Engine Company. The dynamos are to be furnished by the General Electric Company. They foot up to the neighborhood of 1,000 horse-power. For the new store of R. H. Macy & Co. a power equipment of about three times that amount was ordered earlier, the larger engines, we understand, to be Rice-Sargent, while two 325 horse-power tandem compound engines for this plant will be built by the Phœnix Iron Works Company, of Meadville, Pa. The Western Electric Company will supply generators for it. The Hanover National Bank is to install three Payne engines and three 100-kilowatt Crocker-Wheeler generators.

The Westinghouse Machine Company, which is now building horizontal Corliss engines and blowing engines, is booking some pretty good orders in those lines. The Hartford (Conn.) Street Railway Company is to install a Westinghouse horizontal Corliss engine of 1,000 or 1,200 horse-power with Westinghouse generator. Two cross-compound horizontal engines of that make will go into the plant of the Syracuse (N. Y.) interurban railway. We have previously mentioned orders taken for six Westinghouse blowing engines. The three for Toledo, Ohio, are intended for the plant of the Toledo Furnace Company and the other three are for the South Chicago Furnace Company.

The Ames Iron Works are shipping a quantity of power machinery to the East Indies, among which is a complete lighting plant for the Sultan of Linga. The company's order books are so well filled that it could get through the year comfortably without taking another contract. People are almost ready to steal boilers in order to get them. The company advanced boiler prices 2½ per cent. April 1, and has also advanced automatic engines. Mr. Merriam of the company made a trip to Mexico not long ago and while passing through Texas and Louisiana was much impressed with the prosperity of the South. The concern is receiving better orders for boilers, etc., from that section than ever before.

Among the engine and boiler building companies that are now enlarging their capacity is the Phœnix Iron Works Company at Meadville, Pa. One of the improvements is a 300-foot boiler-shop addition. The company is exceedingly busy executing orders and has been so for a long time past.

A portion of the plant at Cudahy, Wis., of the recently organized Holthoff Machinery Company is so far completed that the company is now about occupying its new office building and one of its shops. It is expected that the entire plant will be ready by the latter part of May or somewhat later. The plant will be fully equipped for the manufacture of engines, mill machinery, etc., and it is understood that the company will be crowded with orders as soon as it is ready to operate.

The Sprague Electric Company sends a partial list of very recent orders for split-pole generators, from which we abstract the following: E. L. Epperson Construction Company, St. Louis, 200-kilowatt engine type, 200 revolutions per minute, 550 volts; Keystone Leather Works, Camden, N. J., 200-kilowatt engine type, 200 revolutions per minute, 230 volts; Providence & Danielson Railway Company, Providence, 400-kilowatt belted type, 400 revolutions per minute, 575 volts; E. W. Bliss Building, New York, four 150-kilowatt engine type, 225 revolutions per minute, 250 volts; Lackawanna Iron & Steel Company, Buffalo, 500-kilowatt engine type, 100 revolutions per minute, 250 volts; Otis Elevator Company, Yonkers, 50-kilowatt engine type, 290 revolutions per minute, 250 volts; Railroad Construction Company, Princeton Junction, two 400-kilowatt belted type, 400 revolutions per minute, 575 volts; Sturges, Cornish & Burns, Chicago, 200-kilowatt belted type, 425 revolutions per minute, 250 volts; American Electrolytic Company, Rock Glen, N. Y., 200-kilowatt belted type, 550 revolutions per minute, 250 volts.

Options for a site upon which will be built a large electric refining plant for copper have been secured in Pittsburgh by the Occidental Smelting Company of the State of Washington, which expects to secure a charter under the laws of Pennsylvania. The plant, it is said, will cost between $800,000 and $1,000,000. Contracts for the equipment, it is understood, will be let to the Westinghouse Electric & Manufacturing Company. The company is now beginning to erect a smelting plant on Puget Sound, Washington, with a daily capacity of 1,200 tons of ore. The Allis-Chalmers Company of Chicago has this contract.

The Northwest Steamship Company is making interior changes in its crack passenger boats "Northwest" and "Northland," including the installation of new boilers of the Scotch marine type. They will put on each boat an electric lighting set consisting of two horizontal tandem compound engines made by the Buffalo Forge Company, direct connected with General Electric marine type, 75-kilowatt generators. The engines are specially designed for this contract, the space available being limited, and the order for them has been booked for especially quick delivery. Six Buffalo steel plate fans with direct connected General Electric motors will be

installed in each steamer for ventilating purposes.

STEEL MILLS, STEEL CAR SHOPS, ETC.

The problem of keeping the country's industrial activity up to its present almost turbulent stage cannot but be greatly simplified by the intention of the United States Steel Corporation to spend about $30,000,000 in improving and extending its works. Perhaps it is not generally realized what a big undertaking the new Homestead armor plate works constitute. They will cost nearly $8,000,000 and will involve the practical reconstruction of the plant. The new shop will have double the productive capacity of the old, and will, it is claimed, rival the Krupp armor works at Essen. The old plant will be used hereafter as a protective deck department. The new 12,000,000-pound forging press, it is thought, may be built by the Allis-Chalmers Company. The present large press was made in England. A sharp competition in tube manufacture has arisen against the trust in the last year, the present outside mills being estimated at half the capacity of the National Tube Company. It is now stated on what claims to be semi-official authority that the Conneaut (O.) tube mills planned by Mr. Carnegie just before the trust was formed will be constructed and on a scale to employ 6,000 instead of 3,000 men. It is not, however, made quite clear whether the trust intends to build this mill or whether Mr. Carnegie proposes to do it on his own hook. If the latter, since Mr. Carnegie is a large security holder of the United States Steel Corporation, he will present much the appearance of a dog chasing its tail around a stump.

In connection with the extensions that are being made by the Steel Trust's chief competitor, Jones & Laughlins, Ltd., the latter have bought land for a steam plant to afford an additional capacity of 6,000 horse-power. It is to be in operation in four months and to cost $100,000.

The new industry of building steel freight cars to replace the old-style wood car is developing into a more extensive business than was anticipated by the promoters and patentees. The Pressed Steel Car Company is turning out about 100 finished cars daily. The output of the factory to March 27, 1902, has been 60,000 cars, equal to a train 360 miles long.

The steel-car industry is outcropping prominently in several different quarters just now. The plans of the American Car & Foundry Company to build at Berwick, Pa., another plant substantially duplicating its new one at Detroit, Mich., form one of the chief items. Westinghouse, Church, Kerr & Co., who had the engineering for the Detroit plant, are also engaged on that for the new one, including the power equipment. In view of the demand for steel cars, it is almost paradoxical that the American Car & Foundry Company's report for the quarter ending February 28 shows earnings of only $780,642, a decrease of $138,156 against the corresponding period of last year, but this is explained by the scarcity of material which diminishes the output. The Standard Steel Car Company, in which the Schoens, originators of the Pressed Steel Car Company, are heavily interested, and which has already ordered structural material and machinery, has at last chosen a location at Butler, Pa., where it will have 300 acres —100 for plant and extensions and 200 for buildings of employees. Further, Charles T. Schoen has a project up his sleeve for making car wheels of pressed steel. He is said to have interested Mr. Schwab, and experiments are to be made at the Bethlehem Steel Works. There is a rumor that prospectors are looking for a site at East Geneva, N. Y., for a large palace and freight (not steel) car works. We mentioned last week the possibility of the establishment there of a car plant of the Rochester & Eastern Rapid Railroad, and it may be in relation to this that the rumor has arisen.

A monster steel shaft just completed for the new steel hull towboat "Sprague" is creating considerable notice, it being the largest shaft ever made for a river boat. The diameter is 31 inches, and it is 47 feet 2 inches long, hydraulic forged, with a 21-inch hole in the center and weighing 80,220 pounds. The shaft is made by the Bethlehem Steel Company and forged from nickel steel. The steamer "Sprague" will be the largest of its kind ever built in this country, 300 feet long and 65 feet beam, it being made for a Pittsburgh coal and coke company.

The Uniform Steel Company, 320 Broadway, New York, will remove its plant next September or October from Newark, N. J., to Rahway, N. J., where they will have larger quarters and better shipping facilities. They have bought a plant in Rahway for over $45,000 and will, it is understood, spend $40,000 or $50,000 more there. Molding machines will be installed and the latest improved methods of steel making employed. The company owns a secret process by which it is claimed cast steel is made equal to the best forged steel. It is claimed further that by its process the castings are kept free from blow holes and equal to the highest grade of crucible steel. A specialty is made of castings for automobiles. The company employs 125 hands. The officers are: N. F. Burns, president; G. Milton Schatzkin, vice-president; G. T. Rogers, treasurer; A. E. Williamson, secretary; Walter H. Gray, assistant secretary. The capital stock is $500,000, of which $400,000 is paid in.

MISCELLANEOUS.

The Niles Tool Works Company, Bement, Miles & Co., the Pond Machine Tool Company and the Pratt & Whitney Company have removed their Pittsburgh offices to 1223-1224 Frick Building.

We have advices direct from Trinidad, B. W. I., that a fire has just destroyed the entire wood-working plant of the Trinidad Shipping and Trading Company, Ltd., of Port of Spain, on that island. This may furnish a chance for American wood-working machinery. The company has an office at 29 Broadway, New York city.

The Burt Manufacturing Company, Akron, Ohio, has made a shipment of sixteen oil filters to one of its customers in Meridad, Yucatan.

The proposed incorporation and enlargement of the Dexter Harrington & Son cutlery manufacturing concern at Southbridge, Mass., calls attention to the age of this establishment, which has been carried on in the family name for eighty-four years, having been founded by Henry Harrington, Sr., at the same location in 1818. The firm formerly confined its output to shoe knives, but of late has manufactured knives for a variety of industrial and household purposes. It employs many special machines original with itself, the design of which is not made public. The new plant, which will be on a new site and which will be three times the capacity of the old, will contain additional machines, the orders for many of them having already been placed.

Pawling & Harnischfeger, Milwaukee, Wis., report a continued excellent demand for electric cranes. They have recently booked orders for forty-five cranes and hoists, a few of which are as follows: Allis-Chalmers Company (Fraser & Chalmers plant), Chicago, one 20-ton with 5-ton auxiliary; Allis-Chalmers Company (Gates plant), Chicago, one 50-ton with 5-ton auxiliary; Bradley Manufacturing Company, Allegheny, Pa., one 6-ton; Fairbanks, Morse & Co., Beloit, Wis., one 15-ton; Newport News Shipbuilding & Dry Dock Company, Newport News, Va., two 20-ton; Whitney Iron Works Company, New Orleans, La., one 10-ton and one 20-ton; American Bridge Company, Philadelphia, one 20-ton, double-trolley; Structural Steel Car Company, Canton, Ohio, one 12-ton; Norton Emery Wheel Company, Worcester, Mass., one 10-ton; Follansbee Bros. Company, Pittsburgh, one 5-ton, one 10-ton with 3-ton auxiliary, and one 25-ton; American Sheet Steel Company, Wellsville Works, Wellsville, Ohio, one 30-ton with 5-ton auxiliary; William B. Pollock Company, Youngstown, Ohio, one 20-ton riveter with 5-ton auxiliary.

The American Steel & Wire Company, of New York, has been awarded the contract for furnishing 3,343,000 feet of copper wire for the electrical power circuit of the World's Fair at St. Louis. The contract price is $200,000.

CHICAGO MACHINERY MARKET.

For several months a common remark for the sellers of boilers and engines to make has been that inquiries were slow in closing. The inquiries hang fire sometimes to an unconscionable length of time.

Last week, to illustrate this condition of affairs, the A. H. Andrews Company, Chicago, closed a contract with the Stirling Company for a 250 horse-power boiler, bids for which had first been asked from the representatives of boilermakers here three years ago. This is, of course, an exaggerated case. Another illustration may be made. The salesman of a boilermaker says that in the past three months he has sold boilers to the extent of about 4,000 horse-power. He has on his desk now live inquiries for about 20,000 horse-power, most of it running in lots from 500 horse-power up. The present indications are that much of this business will be closed in the near future. It is largely for increased capacities of manufacturing plants now in operation. The representative of one large maker of boilers says that the aggregate trade for March did not come up either to the January or February amount, but that the promise is for a very active trade. When the future is mentioned, there is but one opinion. That is that only brightness appears. No one sees the faintest indication of anything else. Nor do all makers of power and accessories speak in measured praise of recent trade. With some of them, the present is the most active period in their history. It is not uncommon for factories to be reported to be running twenty-four hours a day and seven days a week. There is a scarcity of labor, both skilled and unskilled. An unusual percentage of the men are moving constantly from shop to shop and from town to town, a condition that invariably accompanies a high tension of shop activities. This migratory instinct thus indulged makes the question of satisfactory labor more difficult.

The Bates Machinery Company, Joliet, Ill., has sold a 2,000 horse-power engine to the Sleepy Eye Rolling Mill Company, Sleepy Eye, Minn.; also a water purifying system, consisting of three units of 500 horse-power each, to the Highland Iron and Steel Company, Terre Haute, Ind. The Tudor Boiler Manufacturing Company has sold a 3,000 horse-power boiler to the Diamond State Steel Company, Wilmington, Del. The Fort Wayne Foundry and Machine Company, Fort Wayne, Ind., is considerably behind in its orders and is running at maximum capacity. The Heine Safety Boiler Company, St. Louis, Mo., has sold a 500 horse-power boiler to the Illinois Valley Traction Company, La Salle, Ill. Quite a little business in Chicago locally is picking up. One seller of power says that in fifteen years he has never known it to be so good.

Quotations.

NEW YORK, Monday, April 7.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$19 15 @ $19 65
No. 2 X	18 65 @ 19 15
No. 2 plain	18 15 @ 18 65
Gray forge	17 65 @ 18 15

Alabama Pig, New York delivery:

No. 1 foundry, or soft	16 25 @ 19 25
No. 2 foundry, or soft	15 75 @ 18 75
No. 3 foundry	15 25 @ 18 25
Foundry forge, or No. 4	14 75 @ 17 25

The minimum quotations on Alabama iron are the prices at which certain producers would sell iron if they had it, and the actual minimum price is somewhere near the maximum quotation given above.

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. in carload lots. Smaller quantities from store, about 2.10c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.00 @ 2.10c.

Cold Rolled Steel Shafting—Base sizes—From store, 2¾c.

Copper—Lake ingot, 12⅛ @ 12¼c.; electrolytic, 12 @ 12⅛c.; casting, 11¾ @ 12c.

Pig Tin—In 5- and 10-to lots, f. o. b., New York, 27¾c.

Pig Lead—4.10 @ 4.12½c. in 50-ton lots.

Spelter—4.35 @ 4.40c., New York delivery.

Antimony—Cookson's, 10 @ 10½c., according to quantity upward from one cask; Hallett's, 8 @ 8⅜c.; U. S., 8⅛ @ 8½c.; various brands, 7¾ @ 8c.

Lard Oil—Prime City, 80 @ 81c., according to brand and quantity.

New Catalogs.

The Gosheen Manufacturing Company, Canton, O., publishes an illustrated pamphlet in the interest of its "Carbonizing Coating" for protecting iron and steel structures, etc., from rust and corrosion. It is 10x7 inches.

We have received two pamphlets (about 3½x6¼ inches) relating to the Mergenthaler-Horton Basket Machine Company (executive offices, 287 Broadway, New York) and the machines it is organized to manufacture.

The Hartig Standard Gas Engine Company, 39 Pey street, New York, sends a catalog of the Hartig gas engines for general power purposes, pumping gas engines, marine engines and the "Dandy" ice breaker. Size of page, 9⅛x6⅛ inches.

We have received a catalog of the "St. Louis Corliss" engines, built by the St. Louis engines assembled and in detail. The catalog (Mo.) Iron & Machine Works. Several views of the works are included, as well as of the is 8¾x5¾ inches.

The Clark Automatic Telephone Switchboard Company, Providence, R. I., has sent us a new catalog describing its automatic intercommunicating system for towns, factories, mills, mines, warehouses, hotels, private residences, steamships and offices. The pamphlet is 6x9¼ inches.

The Chase Pulley Company, Providence, R. I., publishes a catalog of the Chase wood rim pulley, solid or split, with iron hubs and arms. There are some illustrations, among others, of the pulleys in process of construction. Several pages of priced tables of sizes are contained. The pamphlet is 6x9¼ inches.

We have received a copy of the 1902 catalog of the Evans Friction Cone Company, 85 Water street, Boston, Mass. It describes the Evans friction cone countershaft for driving machinery at different speeds. Eight thousand sets of this device are in use in America and Europe, transmitting from 1 to 40 horse-power. The catalog is 8x5 inches.

Harry J. Perkins, naval architect, Grand Rapids, Mich., has sent us a booklet of designs of modern launches, fast cruisers and speed boats, gasoline, steam or electric. The pamphlet is introductory to the complete working drawings and specications, which Mr. Perkins makes a business of supplying to boat builders. It is 9¼x6 inches.

The Millett Core Oven Company, Brightwood, Mass., has brought out its 1902 catalog, describing a line of core ovens. We note among them a portable oven. There are line drawings showing how large brick ovens may be set, and also an improved method of erecting brass melting furnaces upon I-beams instead of with brick piers. The pamphlet is 7⅝x9½ inches.

We have received a general university catalog of the New York University. It forms a number of the New York University Bi-Weekly Bulletin, published at Washington Square, New York city. This old-established institution covers in its curriculum courses in applied science and in commerce. A summer school is provided for in its calendar. The book is 5¾x8½ inches.

Armstrong Bros. Tool Company, 617 Austin avenue, Chicago, Ill., has published a new edition of its tool-holder catalog. The pamphlet sets forth the company's line of tools, using inserted cutters of self-hardening steel and intended for turning, planing, boring, slotting, threading and cutting off metals. Other shop specialties, including drill and reamer holder, clamp lathe dog and planer jack, are presented. The catalog is priced. It is 3½x6 inches, standard size.

Manufacturers.

The Globe Iron Works, Minneapolis, Minn., will enlarge its plant.

The Marshall Iron Company, Newport, Del., is building a new sheet-iron room.

The Goodall Worsted Company, of Sanford, Me., is to erect a new mill.

A buggy and carriage factory is to be built by John Ernsdorff & Sons Company, Dubuque, Ia.

It is reported that the Southern Pacific will erect a new 120x250-foot shop at El Paso.

The Mallison Braided Cord Company, Athens, Ga., will add some new spindles and looms.

Plans have been filed for a foundry building for the Creswell & Waters Company, at Nicetown, Pa.

Thomas Quintana and John Hanna are building a machine shop and foundry in San Luis, Cal.

The Bowie & Jeter Company, Doswell, Va., will rebuild its excelsior factory, which has been burned.

The Rossie Velvet Company, of Mystic, Conn., will erect an additional velvet mill, 250x100 feet.

The Tyler Tube & Pipe Works, Washington, Pa., are to be extended at a cost of at least $60,000.

An addition is being built to the stove foundry of Oscar G. Thomas, Weir Village, Taunton, Mass.

The Ewart Manufacturing Company, link belting, will erect a $50,000 factory building at Indianapolis.

The Wilson Sash & Blind Factory, Buffalo, N. Y., has been destroyed by fire. The concern will rebuild.

Improvements are being made to the saw handle factory of H. Disston & Sons, Inc., Philadelphia, Pa.

Plans have been prepared for a manufacturing building for the Detroit (Mich.) Range & Boiler Company.

A Chicago permit has been granted to W. S. Cumming for a foundry at 1121-1123 West Twenty-first street.

The plant of John A. Dunn, chair manufacturer, Gardner, Mass., has been burned, but will be rebuilt.

A Cleveland, O., building permit has been issued for a foundry to be built by the Interstate Foundry Company.

A new company known as the Carlton Paper Mills has purchased property at Clifton, N. J. They will build a factory.

The General Fireproofing Company, Youngstown, O., will locate a plant at Crab Creek to employ about 600 men.

The R. Neumann Hardware Company, manufacturer of bag frames, Newark, N. J., will build a factory addition.

It is reported from Woonsocket, R. I., that a mill occupied by the East Blackstone Woolen Company has been burned.

The Lisk Manufacturing Company, tinware, Canandaigua, N. Y., is preparing for the erection of another factory building.

The Garwood Foundry & Machine Company, Garwood, N. J., has contracted to have a machine shop building erected.

The I. B. Kleinert Rubber Company, 725 Broadway, New York, has filed plans for a rubber factory in Queens Borough.

The American Horse Shoe Company, Phillipsburg, N. J., has purchased the property on which it will build its new plant.

The Stanley Rule & Level Company, of New Britain, Conn., has applied for a permit to erect a five-story factory, 40x173 feet.

It is understood that plans have been drawn for a factory building for Quackenbush & Son, carriage hardware, Paterson, N. J.

A new enterprise which will be located in Augusta, Ga., and which will erect a plant at once, is the Hall-Wylly Lumber Company.

Edwin L. Smith, Westfield, Mass., contemplates forming a company to manufacture thread. Plans are being drawn for a factory.

The Pittsburgh (Pa.) Meter Company is building an addition to its plant at East Pittsburgh, erecting a brass foundry, 55x80 feet.

The Fairmont, W. Va., glass works of the National Glass Company, Pittsburgh, Pa., are to be enlarged and much new machinery added.

Troy, Ala., is to have another oil mill and guano factory. Fox Henderson, president of the Farmers' and Merchants' Bank, is behind this new enterprise.

The A. B. See Electric Elevator Company, 220 Broadway, New York, has bought a tract at Lafayette, Jersey City, where it will build a new manufacturing plant.

It is stated that there is no likelihood of the Canada Atlantic Railway shops being removed from Ottawa, but that more money than ever will be spent there.

McAleary, Wallin & Crouse, manufacturers of rugs, mats and carpets, Amsterdam, N. Y., are making arrangements to build a five-story addition to their carpet plant.

Work has begun on the foundry of the Shaw-Gerlinger Steel Casting Company, which was recently incorporated for the establishment of a business at West Allis.

A 300x350-foot building with room for twelve factories is proposed to be erected at St. Joseph, Mo. It is being promoted by Dr. E. J. Witt and Edward McConnell.

C. H. Masland & Sons, carpet and rug manufacturers, at Amber and Westmoreland streets, Philadelphia, Pa., are having plans drawn for an additional velvet mill.

Plans have been prepared for a new building for the Farist Steel Company, Bridgeport, Conn., on the site of its machine shop, which was destroyed by fire recently.

A woolen mill is proposed for Oakland, Me. W. T. Haines, of Waterville, and George W. Taylor, of Camden, were movers in the project. A stock company will be formed.

The Blakesley Novelty Company, Bristol, Conn., will convert a building formerly used by the Sessions Foundry Company into a factory and will add a building, 112x38 feet.

The J. H. Baker Manufacturing Company, general forging, at Tarentum, Pa., will double the capacity of its plant. An addition, 325x80 feet, will be erected and 200 men and boys employed.

An Allegheny, Pa., permit has been issued for the erection of a machine shop building in Pennsylvania avenue, near Grant avenue, for the Bradley Manufacturing Company, to cost $10,000.

Work has begun on an addition to the Columbia bridge works at Carnegie, Pa., 30x80 feet. After its completion two mill buildings will be put up by the same company on adjoining land.

Work will soon be begun by the Winton Motor Carriage Company, Cleveland, O., on a one-story factory that will cover the larger part of a 12-acre tract of land recently purchased there.

O. O. & A. D. Porter, manufacturing machinists, Grand Rapids, Mich., will build an addition, 50x30 feet, two stories. The demand for the company's wood-working machinery is growing.

A meeting of citizens has been held at Hoosick Falls, N. Y., to consider plans for rebuilding the Noble & Johnston Machine Company's paper machine manufacturing plant, recently burned.

The directors of the Parker Mills, Fall River, Mass., have voted to construct a new weaving shed in Warren, R. I. It will contain, 1,600 looms. This will entail the addition of about 35,000 spindles.

The works of the Johnston Railroad Frog & Switch Company, Chester, Pa., are being enlarged. An electric traveling crane is to be installed in the new annex and a space will be portioned off for a pattern shop.

Work on the foundation for a new spinning mill which will give employment to 500 hands has been commenced in Olneyville, R. I. The new plant is to be an addition to the properties of the Fletcher Manufacturing Company, Providence.

The Skinner Chuck Company, New Britain, Conn., which built an addition to its plant last summer, more than doubling its floor space has just purchased 10,000 square feet of land adjoining its plant and fronting on the railroad.

The Southern States Portland Cement Company, with a capital stock of $2,000,000, has been incorporated in Georgia. W. F. Cowham, of Jackson, Mich., is president. The offices will be in Atlanta and the plant at Rock Mar, Ga.

The Ingram-Richardson Manufacturing Company, Beaver Falls, Pa., contemplates building an additional furnace, putting in a new pulverizing machine and other apparatus. The company has large orders on hand for enamel washboards.

The contract has been awarded for carpenter and mason work on the new radiator factory to be erected at Utica, N. Y., by the New York Radiator Company, which is composed of the members of the Hart & Crouse Company, of that place.

Plans have been prepared for a manufacturing plant, including a machine shop, 100x80 feet, for the Lloyd Construction Company, Detroit, Mich., who will engage in the manufacture of machinery, especially for the construction of gas works.

The Bettendorf Axle Company, Davenport, Ia., will build a new factory at Gilberttown, near that city. The plant will employ 1,000 men. The main shop will be 750x250 feet, and the power-house 200x150. The mechanical draft system will be used.

Clarence Mourse has become associated with Curtin & Butts in the management of their foundry at Alexandria, Va. The firm will be incorporated under the name of the Alexandria Iron Works, and it is the purpose of the company to enlarge the plant.

The Pliable Polishing Machine Company has been organized at Kittery, Me., and will, it is said, oppose the United States Shoe Machine Company. The promoters are Albert E. Knowlton, of Malden, Mass., and Charles C. Smith, Mark W. Paul, C. M. Prince and William P. Huelin, all of Kittery, Me.

The Toledo (O.) Asphalt Patcher Company has been formed. The company is capitalized at $20,000, and the incorporators are Herman Merriman, C. E. B. Lamson and Charles R. Clapp. The company expects to erect a factory in the near future and will manufacture its pavement repairing machines in Toledo.

A new manufacturing concern, to be known as the Transparent Compressible Tube Company, is about to start a plant in New Brunswick, N. J. The company will be capitalized at $100,000 and will embrace the Transparent Collapsible Tube Company, owned by P. T. B. Nevins and Leon Feval, which is now doing business in Highland Park.

The Waterbury Farrel Foundry & Machine Company, Waterbury, Conn., which is improving and enlarging its plant, has completed a four-story factory, 200x48 feet. An industrial railway will connect all the floors with the elevator, and a 20-ton electric traveling crane is about to be installed. An office building and an elevator and boiler-room are among the additions.

It is reported at Bridgeport, Conn., though with some contradictory rumor, that plans are in preparation by the company's engineer, G. L. Leutscher, for the new plant which the American Tube & Stamping Company proposes to erect in the East Side. There will, it is claimed, be a blooming mill and open-hearth mill, 110x600 feet, with a boiler and engine room and machine shop, 60x200 feet.

The following is among the certificates of condition that have been filed with the Secretary of the Commonwealth of Massachusetts: Thomson-Houston Electric Company, of Lynn, Mass., dated January 1, 1902. Assets—Land and buildings, $606,276; machinery, $531,148; cash and debts receivable, $6,468,602; manufactures, merchandise, etc., $893,973; patent rights, $1,500; total, $10,000,000. Liabilities—Capital stock, $10,000,000.

H. G. Barr & Co., manufacturers of special machinery, Worcester, Mass., whose lease expires July 1, expect to move to another building and may erect one for themselves with about 12,000 square feet of floor space. George E. Brownell, manufacturer of twisting machinery, at 49 Union street, Worcester, Mass., has decided to increase the force of help employed there, and will put in new machinery and occupy the first floor of the building where H. G. Barr & Co. are now situated. New multiple-spindle drills, grinding machines and milling machinery will be added.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Stamping dies. Emmons Collins, Chicago.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Partner in gasoline engine business; some capital required. Address Box 329, AMERICAN MACHINIST.

For Sale—Part or whole of patent on good selling machine; nice profits. Address Box 343, AMERICAN MACHINIST.

Special tools, models, fine light mach'y and foundry work wanted. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

For Sale—U. S. patent 696309, "Multiple Lathe Gage," of interest to lathe builders. E. J. Bowers, 2125 Ontario st., Philadelphia.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

Specialty Wanted—Small machine tool or hand tool to manufacture and market, by an established concern. Address "Specialty," care AMERICAN MACHINIST.

Practical machinist, speaking English, German and Russian, intending to visit Europe, desires to handle a line of tool-making machinery. Box 354, AMERICAN MACHINIST.

Machinery designed, mechanical drawings, blueprints, plans for power-houses, power transmission; 20 years' experience. "Engineer and Draftsman," Box 344, AM. MACH.

Wanted—Contract work for 34 in. x 8 ft. planer, 32 in. lathe raised to 48 in., 20 ft. between centers; also full line of smaller tools; also first-class foundry. Box 298, AM. MACH.

Wanted—Working drawings or blueprints of gate valves, with and without yokes, from 3 to 24 in.; also of two-, three- and four-way hydrants, light patterns, latest designs. Price and particulars to Box 315, AMER. MACH.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

To makers of plain and universal milling machines, brass working machinery, boring and turning mills and bolt-cutting machines—An English firm of machinery importers desires to communicate with above, with a view of arranging exclusive agency for Great Britain. Address Box 335, AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Mechanical draftsman with experience wishes to change. Box 356, AMER. MACH.

Machinist draftsman with experience wishes position. Box 341, AMERICAN MACHINIST.

Mechanical draftsman desires position; 5 years' experience; also practical machinist. Box 358, AMERICAN MACHINIST.

Young man, 19, 2 years' experience on machine tool drawing, wants similar position; good references. Box 352, AMER. MACH.

Draftsman as designer on special or printing machinery; 4 years shop, 8 years drafting; A1 references. Box 357, AMER. MACH.

Millwright position wanted by a young man; 12 years' experience in steam, engineering, erecting and maintenance. Box 347, AMERICAN MACHINIST.

Mechanical engineer, 33, with extensive experience in constructing, desires well-salaried position in New York or vicinity. Box 350, AMERICAN MACHINIST.

Wanted—Position as superintendent, manufacturing bedstead mounts and trimmings or general brass goods. Address "Bedsteads," care AMERICAN MACHINIST.

Mechanical engineer, graduate, extensive experience in gasoline engines and automobile, seeks responsible position. Address "Auto," care AMERICAN MACHINIST.

Machine shop foreman who has had 15 years' experience in both light and heavy work, desires to make a change May 1. Box 349, AMERICAN MACHINIST.

Foreman patternmaker desires a position; has up-to-date methods and good reasons for changing; reference present employers. Box 351, AMERICAN MACHINIST.

Responsible position wanted by expert on automatic machinery; draftsman, engineer, superintendent; 10 years' experience; age 31; technical graduate. Box 307, AM. MACH.

Superintendent of printing press works, expert draftsman and mechanical engineer, desiring change, solicits correspondence with reliable firms; excellent references. Address Box 247, AMERICAN MACHINIST.

Position as superintendent or foreman, by practical mechanic, up to date in modern methods, organizing and the handling of men to obtain best results; interchangeable machinery and specialties. Box 348, AM. M.

Position desired by technical graduate, international training, age 32; 10 years' experience devising and superintending construction of machinery and the manufacture of small parts on interchangeable lines; at present in Germany; good handler of help. Address Box 332, AMERICAN MACHINIST.

Aggressive, educated man of brains, 34, machinist draftsman, exceptionally good on fine precision work, any difficult die or instrument, designed automatic tools, superintended, organized, wishes place as foreman, designer or toolmaker, with prospects. Box 353, AMERICAN MACHINIST.

Wanted—Position as general foreman or superintendent; experienced in machine building and in manufacturing small apparatus on interchangeable lines; a good manager of help and able to hustle work; best of reference as to character and ability. Address "Superintendent," care AMER. MACHINIST.

A thoroughly experienced English engineer, having a practical knowledge of the drawing office and the business end of an engineering works, desires to represent a first-class American machine tool firm; excellent personal connection throughout Great Britain; highest references. Address Box 345, AMER. MACH.

Mechanical engineer with technical education and practical experience, at present editor of an engineering magazine, would like to hear from responsible parties who may desire his services; can furnish best of references in regard to character, ability, past experience, etc.; at liberty as soon as desirable opening is presented. Address Box 330, A. M.

Engineer, 29, 2½ years as foreman of shop employing 100 men on marine engines, air compressors and heavy machinery, wishes to leave present road job for place as general foreman or assistant superintendent of works engaged in above lines or in heavy engine work; have good education, though not a graduate; references given; West preferred. Box 342, AMERICAN MACHINIST.

An experienced mechanical manager and superintendent would like to correspond with parties in or near New York city who will soon be in want of a first-class man with plenty of push, business tact, executive ability, any amount of inventive genius and practical experience; if you are starting a new concern or wish to revise an old one, I can serve you in an up-to-date manner; highest testimonials as to ability, etc. Box 318, A. M.

Help Wanted.

Wanted—Machinists, lathe hands; steady position. The Michigan Brass & Iron Works, Detroit, Mich.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

We are enlarging our plant and would like applications from first-class machinists. Box 340, AMERICAN MACHINIST.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

Six first-class molders for Corliss engines and other heavy machine castings. Address "Manufacturer," care AMER. MACHINIST.

Wanted, as chief draftsman, a man thoroughly experienced in the design of simple and compound engines. Box 336, AM. MACH.

Four first-class toolmakers, $3; six general machinists and two vise hands at $2.50; 9-hour shop. Call, Mobile Co. of America, Tarrytown, N. Y.

Machinists wanted to act as shop agents and sell small tools where they work. Address E. H. Randall, 235 Woodland ave., Springfield, Ohio.

Patternmaker wanted; first-class man on small and medium-sized work; steady position; good wages; open shop in large Western city. Address Box 333, AMER. MACH.

Wanted—A few mechanical draftsmen for tool and fixture work; state age, experience and salary; permanent positions to good men. Address Box 355, AMERICAN MACHINIST.

Wanted—Foundry foreman for Middle West, in healthy locality, in foundry employing 75 men; applications wanted from first-class men only. Address Box 288, AMER. MACHINIST.

Wanted—Several A1 mechanical or electrical draftsmen; send references and state salary expected. Apply to Engineer, Drafting Dept., General Electric Co., Schenectady, N. Y.

Wanted—Foreman for a large modern brass foundry; must understand the mixing of metals, running machines and handling men; state age, experience, wages expected. Address "Electric," care AMER. MACHINIST.

Wanted—One or two first-class mechanical draftsmen, experienced in general machine design or in the design of coal-mining machinery; state experience, age and salary expected. Address "M.," care AMER. MACH.

Machinists wanted; 10 or 12 good lathe, planer and boring mill hands at once; wages 25c. per hour; permanent position for good men. Address Norman R. Entrekin, Master Mechanic, Worth Bros. Co., Coatesville, Pa.

Wanted—Foreman for small machine shop; one who understands die and other work and is willing to get in and hustle with the rest of the men; good position for the right man; state wages expected. Address Box 338, A. M.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Draftsman experienced in designing dynamos, motors, switchboards and other electrical machinery for direct-current railway and power systems; give age, experience, education and salary expected. Address R. K., care AMERICAN MACHINIST.

Wanted—Two or three good draftsmen; none but those having had experience in building and designing machine tools and fixtures need apply; state age, experience and references. Address Chief Draftsman, Pratt & Whitney Co., Hartford, Conn.

Bradley Manufacturing Company, Pittsburgh, Pa., American builders of the Willans central valve engine, desire a general superintendent for their new works; a man thoroughly acquainted with accurate work is desired. Box 292, AMERICAN MACHINIST.

Wanted—A first-class mechanical draftsman to work in New York city; preferably one experienced on heating furnaces for mechanical purposes; applicants must give references, experience and salary expected. Apply Box 346, AMERICAN MACHINIST.

Wanted—Man competent to take the management of established foundry and machine works employing about 30 men at present; must be well recommended, and it is desired that he take the interest of the retiring manager. Box 339, AMERICAN MACHINIST.

Wanted—Draftsman for light, automatic machinery and small tools; one accustomed to some designing and planning details from suggestions; state age, experience and wages expected; factory located in Worcester County, Mass. Box 314, AMERICAN MACHINIST.

Wanted—Competent manager for old established machine tool works (incorporated) who could take some stock; parties only furnishing first-class references given opportunity to investigate; give experience and amount could invest. Box 312, AMER. MACHINIST.

Wanted—Thoroughly competent foreman on machine tool building, experienced in building pipe threading machinery, familiar with methods of producing duplicate parts on turret lathes; give age, experience, salary expected and references. Box 237, AMER. MACH.

Wanted—An assistant to master mechanic in a large manufactory one hour from New York city; great variety of manufactures; mass of detail work; must have large experience in small, accurate work; exceptional position and good salary. Address Box 337, AMERICAN MACHINIST.

Wanted—By a large works in the East, whose specialty is machine tools, skilled machinists to operate lathes, planers, boring mills, milling machines, chucking machines,

Landis grinders, etc., etc.; also toolmakers and fitters; good wages and steady work to good men; every applicant will receive a reply whether employed or not. Box 326, AM. M.

We are equipping our new shops at Trenton with an increased number of machine tools and require skilled machinists to operate them; we also want fitters, toolmakers, erectors, etc.; our specialties are steam turbines and machine tools; applications are invited from first-class workmen only, to whom we will give steady employment and good wages. De Laval Steam Turbine Co., Trenton, N. J.

Wanted.—Machinists, toolmakers, draftsmen, do you want to increase your salary? They all say that Saunders' enlarged edition "Hand Book Practical Mechanics" exactly fills the bill for valuable shop kinks, rules, etc., figured out by simple arithmetic and drawings; also most complete reference tables in existence, many taken from note books of best mechanics in the country. Pocket size. Price, post paid, only $1, cloth; $1.25 leather. Agents wanted. Book sells itself. Big money. C. H. Saunders, 216 Purchase st., Boston, Mass.

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Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Balls, Steel

Automobile & Cycle Parts Co., Cleveland, O.
Grant Tool Works, Franklin, Pa.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Bearing Metal

Phosphor Bronze Smelting Co., Philadelphia, Pa.
Shonberg, I., New York.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.

Belt Lacing Machines

Diamond Drill & Mach. Co., Birdsboro, Pa.

Bending Machines, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Reade Mchry. Co., Cleveland, O.

Blocks and Tackles

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Blowers
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.

Blue Printing Machines
Pittsburgh Blue Print Co., Pittsburgh, Pa.

Blue Print Wringers
Pittsburgh Blue Print Co., Pittsburgh, Pa.

Boilers
Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Bone for Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Mechanical
Audel & Co., Theo., New York.
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Henley & Co., N. W., New York.

Boring and Turning Mills
Am. Tool Wks. Co., Cincinnati, O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Newton Mch. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Carborundum
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Case Hardening
Rogers & Hubbard Co., Middletown, Conn.

Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Motor
Ferodowill & Co., J. H., St. Paul, Minn.

Castings, Steel
Acme Steel & Mall. Iron Works, Buffalo, N. Y.
Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee Wis.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Chains, Crane
Columbus Chain Co., Columbus, O.

Chains, Driving
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Boston Gear Works, Boston, Mass.
Columbus Chain Co., Columbus, O.
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Whitney Mfg. Co., Hartford, Ct.

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Cleveland Mach. Screw Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K. Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Sons Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Codes
Lieber Code Co., New York.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Countershafts
Builders' Iron Fdry., Provi., R. I.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Couplings, Shaft
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machines
Underwood & Co., H. B., Philadelphia, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Toledo Mach. & Tool Co., Toledo, Ohio.

Drawing Tables and Boards
Rich, J. & G., Philadelphia, Pa.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
Amer. Tool Wks. Co., Cincin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Fosdick & Holloway M. T. Co., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reade Mchry Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
Am. Tool Wks. Co., Cincinnati, O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Elec. Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
General Elec. Co., New York.
General Incan. Arc Light Co., New York.
Triumph Electric Co., Cincin., O.
Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Abro-Clem Elevator Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Whiting Fdry. Equipment Co., Harvey, Ill.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Charter Gas Engine Co., Sterling, Ill.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gas Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.
Weber Gas & Gasoline Eng. Co., Kansas City, Mo.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.

Engine Stop
Consolidated Engine Stop, Co. New York.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Troy File Works, Troy, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Pattern Works, Chicago, Ill.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Works, Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Molded
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Aibro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gleason Mach. Works, F., Philadelphia, Pa.
Gould & Eberhardt, Newark, N. J.
Modern Tool Co., Erie, Pa.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Tool
Anderson Tool Co., Anderson, Ind.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Anderson Tool Co., Anderson, Ind.
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co. Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Toledo Mach. & Tool Co., Toledo, Ohio.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa
Phila. Pneu. Tool Co., Philadelphia, Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Handles, Machine Tool
Schacht Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.
Whiting Fdry. Equipment Co., Harvey, Ill.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Igniter, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Instruction Schools
See Schools, Correspondence.

Instruments, Drawing
Alteneder & Son, Theo. Phila., Pa.

Insurance, Boiler
Hartford Steam Boiler Insp. & Inc. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Joints, Universal
Baush Machine Tool Co., Springfield, Mass.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Gen. Incan. Arc Light Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk Conn.
Pratt & Whitney Co., Hartford conn.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes
American Tool Wks. Co., Cin., O.
Auto. Mach. Co., Bridgeport, Ct.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Fairbanks Mach. Tool Co., Springfield, O.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass
Schumacher & Boye, Cincinnati, O
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Columbia Factory, Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Stowell, J. A., Leominster, Mass.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Reichhelm & Co., E. P., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., Ne wYork.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
Amer. Tool Wks. Co., Cincin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Electric Co., New York.
General Incan. Arc Light Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison Wis.
Robbins & Myers Co., Springfield Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co. Pittsburgh, Pa.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Bevans, James W., Washington, D. C.
Cromwell, W. H., Washington, D. C.
Cullen, Orlan Clyde, Washington D. C.
Patent Title & Guarantee Co., New York.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.

Patterns, Wood
Balkwill Pattern Works, Cleveland, Ohio.
Gobeille Pattern Co., Cleveland, O.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer-Eames Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Sellers & Co., Wm., Phila., Pa.

Planers—*Continued*
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Phila., Pa.

Presses, Hand
Elmes Engr. Co., Chas. F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Engr. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Toledo Machine Tool Co., Toledo, Ohio.

Profilers
Garvin Mach. Co., New York.

Pulleys
Cresson Co., Geo. V., Philadel., Pa.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pumps, Hydraulic
Elmes Engr. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleve., O.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
McCrosky & Huber, Cincin., O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Rheostats
General Incan. Arc Light Co., New York.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Enginering Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Roller Bearing & Equipment Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks.,Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Ohio State University, Columbus, Ohio.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Shafts, Flexible
Chicago Flexible Shaft Co., Chicago, Ill.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.
Toledo Mach. & Tool Co., Toledo, Ohio.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Springs
Cleveland Wire Spring Co., Cleveland, O.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Machinery
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., N. Y. City.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M. Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., The, Cleveland, O.
Pratt & Whitney Co., Hartford, Ct.
Rivett-Dock Co., Boston, Mass.

Time Stamp
Hoggson & Co., S. H., New York.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
McCrosky & Huber, Cincin., O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Allston Foundry Co., Boston, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Whiting Fdry. Equip. Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Unions Brass
Nolte Brass Co., Springfield, O.

Valves
See Steam Fittings.

Vises, Drill
Hollands Mfg. Co., Erie, Pa.

Vises, Metal Workers'
Hammacher Schlemmer & Co., New York.
Merrill Bros., Brooklyn, N. Y.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Blast Furnace with Electric Power Plant at Audun-le-Tiche, Lorraine.

BY FRANK C. PERKINS.

The Audun-le-Tiche Blast Furnace Company recently constructed new blast furnaces on the American system, and at the same time decided to equip its works with a new electric transmission of power installation on the latest and most approved plan.

The electrical plant was installed by the Compagnie Internationale d'Electricité, of Liege, Belgium, who are represented in Great Britain and the colonies by the International Electrical Engineering Company. This company has had exceptional experience in a number of analogous applications of electric power in Belgium, Russia, Great Britain and elsewhere, and particularly in the neighborhood of Liege and Seraing. A general view of the works is given in Fig. 1. To the right is the central station and to the left two of the blast furnaces, which are among the largest in the world. The power station building itself is of very plain construction, as befits an industrial works. The internal arrangements are designed to have everything of as simple a character as possible, the generating plant being arranged to have a minimum amount of steam and other piping.

Two generating units are installed, each consisting of a 400 horse-power direct-connected engine and dynamo running at 120 revolutions per minute. The generators are of the C. I. E. flywheel type with ten poles, directly coupled to engines built by Vanden Kerchove, of Ghent. They are tandem compound condensing engines of the Corliss-Bonjour valve type, and have a capacity of 400 horse-power with a steam pressure of 135-140 pounds.

Each dynamo is compound wound and

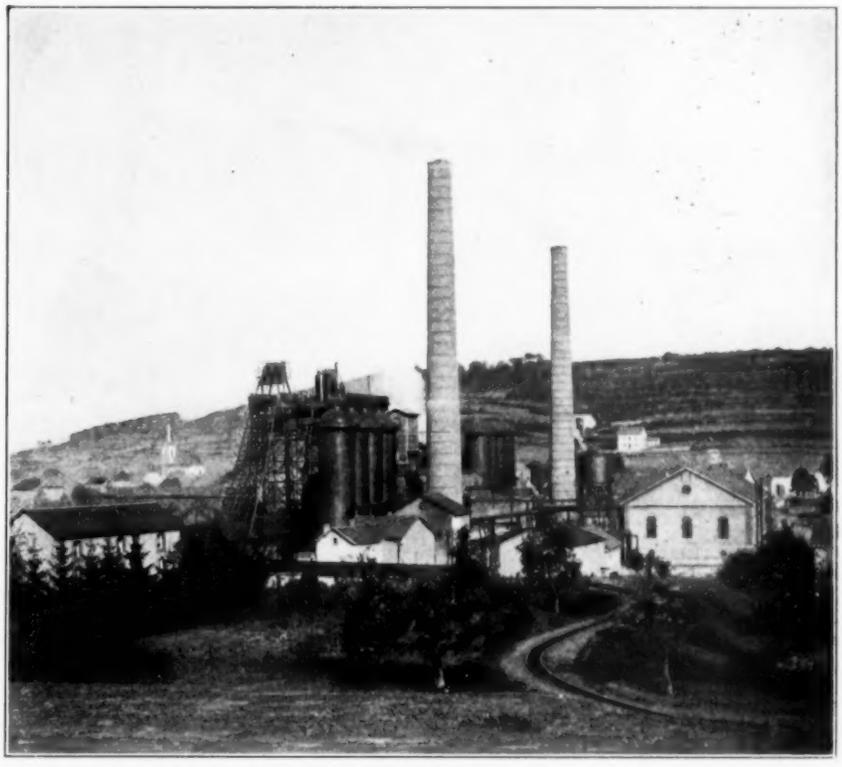


FIG. 1. GENERAL VIEW OF BLAST FURNACE AND POWER-HOUSE AT AUDUN-LE-TICHE, LORRAINE.

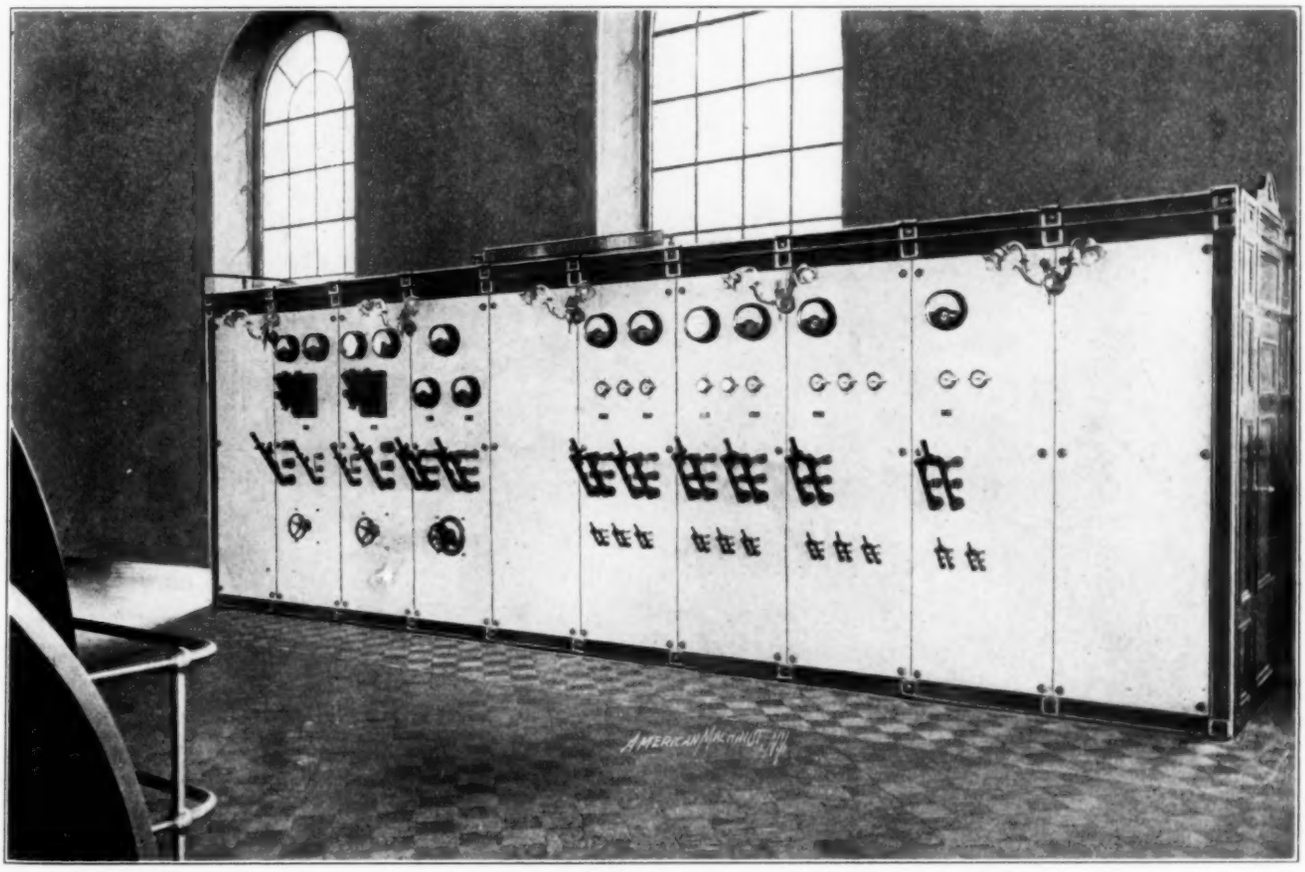


FIG. 2. MAIN SWITCH-BOARD.

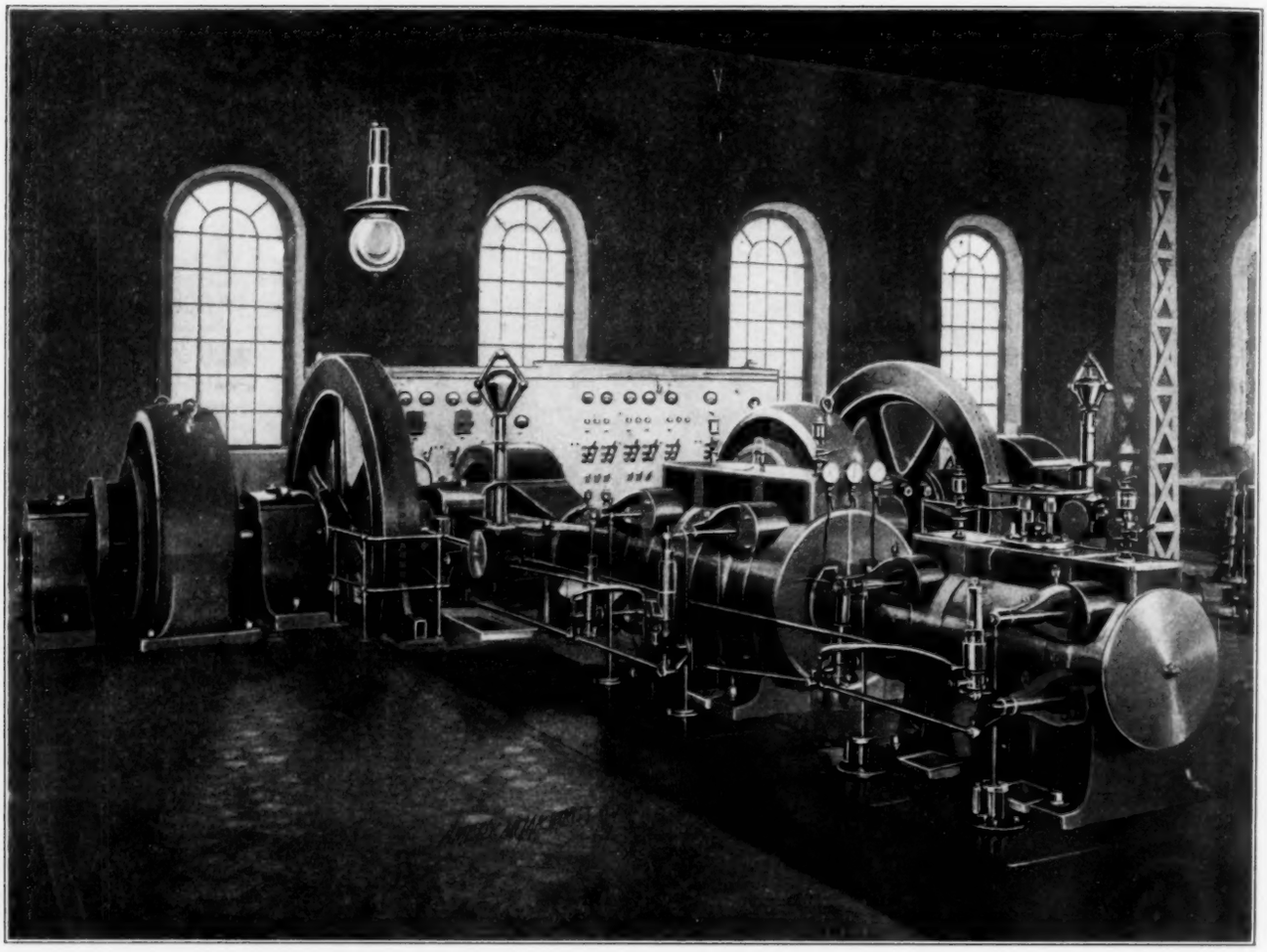


FIG. 3. ENGINE AND GENERATOR ROOM.

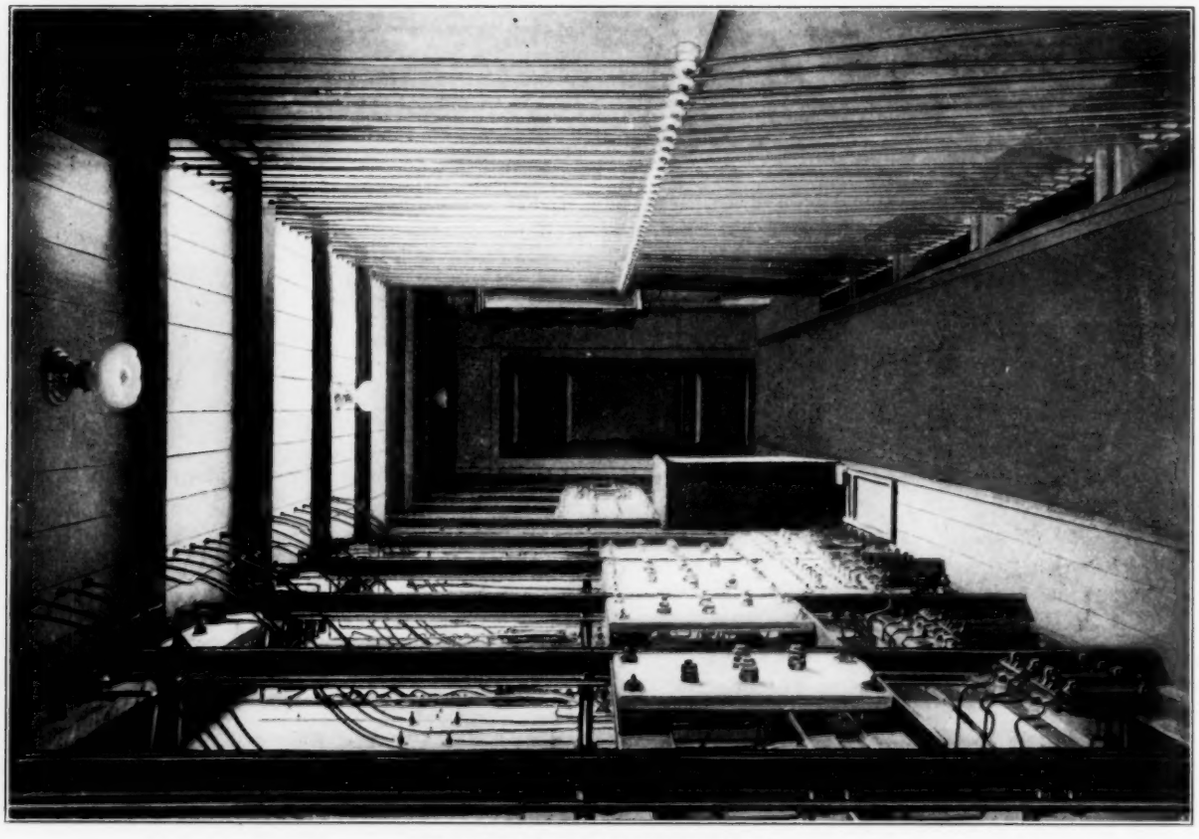


FIG. 4. REAR OF MAIN SWITCH-BOARD.

FIG. 5. REAR VIEW OF BLAST FURNACES, SHOWING INCLINED RAILWAY.

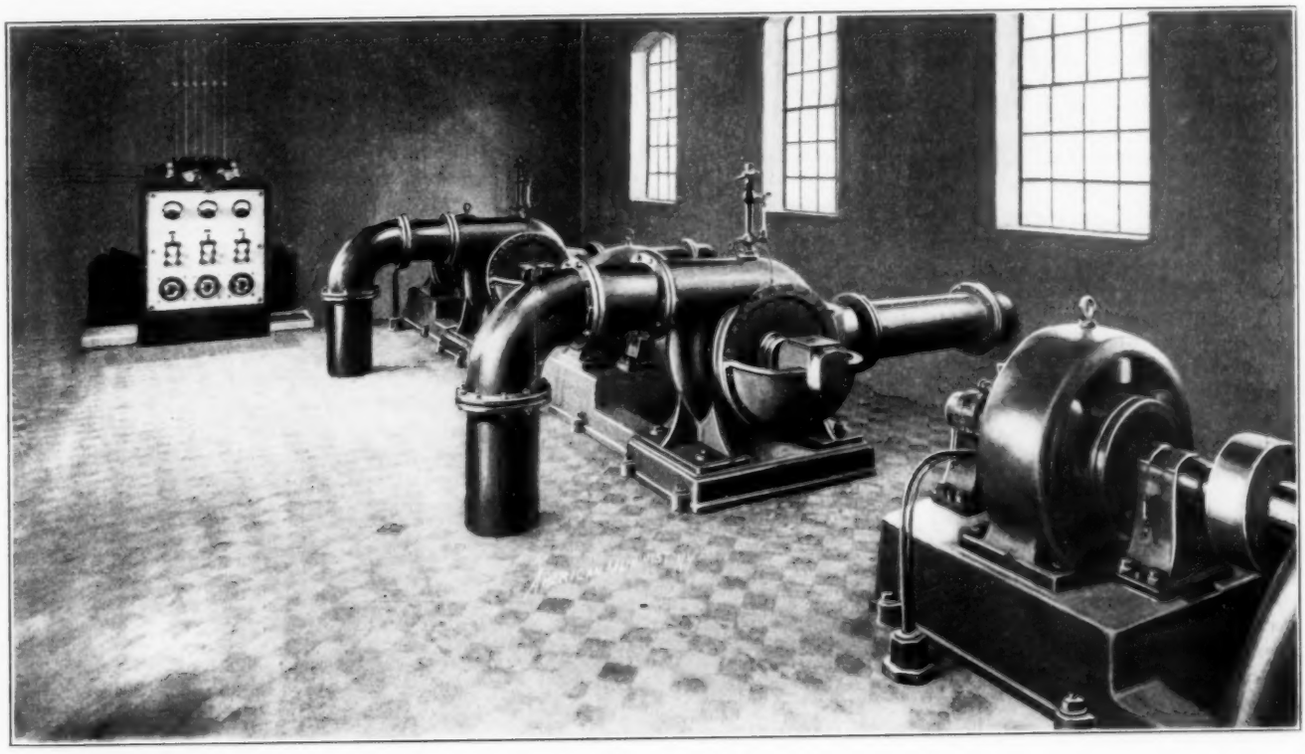


FIG. 6. ELECTRIC PUMP ROOM.

gives 550 volts at its normal output of 300 kilowatts. The armature core is ventilated, and the conductors are shaped on formers, so as to be interchangeable and have a minimum number of soldered joints. The commutator is bolted direct on to the armature hub, and there is therefore only one keying of the hub on to the shaft, and relative movement of the commutator and armature is entirely prevented. The field magnets are of cast steel and have laminated pole shoes shaped so as to reduce eddies to a minimum. The brush rocker spindles are designed so they can be withdrawn without dismantling the rocker in any way. The load varies within very wide limits, and the dynamo is so designed that the brushes work sparklessly with fixed lead.

The electric lighting system consists of thirty-six arc and 300 incandescent lamps, and is arranged on the three-wire system with 225 volts on each side of the central wire. A balancer is provided, consisting of two separate machines coupled, which alternately act as motor or dynamo as the lights are switched on or off one side or the other, and no storage battery plant has been provided.

Figs. 2 and 3 show the switchboard as it is arranged between the two dynamos. It is composed of ten marble panels, each connected either to a machine or to a center of distribution. This method is the usual American practice and facilitates the extension of the switchboard and simplifies the service. The panels are supported by an iron framework, and the greatest care has been given to the arrangements at the back of the board. As shown in Fig. 4, in the rear of the board is a long passage in which the attendant can move freely and without danger. The cut-outs are on marble and the conductors are all vertical, except the omnibus bars, and there is no crossing of wires. The conductors are led from the switchboard to a distribution tower, bare wires being led off in different directions to the various points where motors are required.

The ore, coke, etc., is carried up to the blast-furnace platforms by an inclined railway, shown in Fig. 5, the cars being hauled up by a steel wire rope passing over an electric winding drum equipped with two 13 horse-power motors with slotted armatures. The multipolar conductors consist of form wound interchangeable coils. The commutator is supplied with carbon brushes, and both the motor and controller are each designed for working in an exposed position.

There are three electric pumps located about a quarter of a mile from the power house, current being transmitted by six wires. The pump room is seen in Fig. 6. Each of the pumps is of the Sulzer centrifugal type direct coupled to a 90 horse-power motor and running at 500 turns per minute.

An electric locomotive at the top of the platform hauls the cars to the mouths of the furnaces. These locomotives were built by the Compagnie Internationale d'Electricité at Liege.

The electric locomotives, one of which is seen in Fig. 7, are each supplied with two traction type steel-clad motors of 8 horse-power each carried on spring suspensions as in an electric tramcar. The motors are geared to the axles by simple toothed gear wheels. The electric motors are controlled by the series-parallel system, the controller being fitted with magnetic blow-out to prevent arcing. The motorman has within easy reach all the necessary apparatus, brakes, sand-box and automatic switch. Current is collected by means of a bow trolley, the return being through the rails, which are carefully bonded.

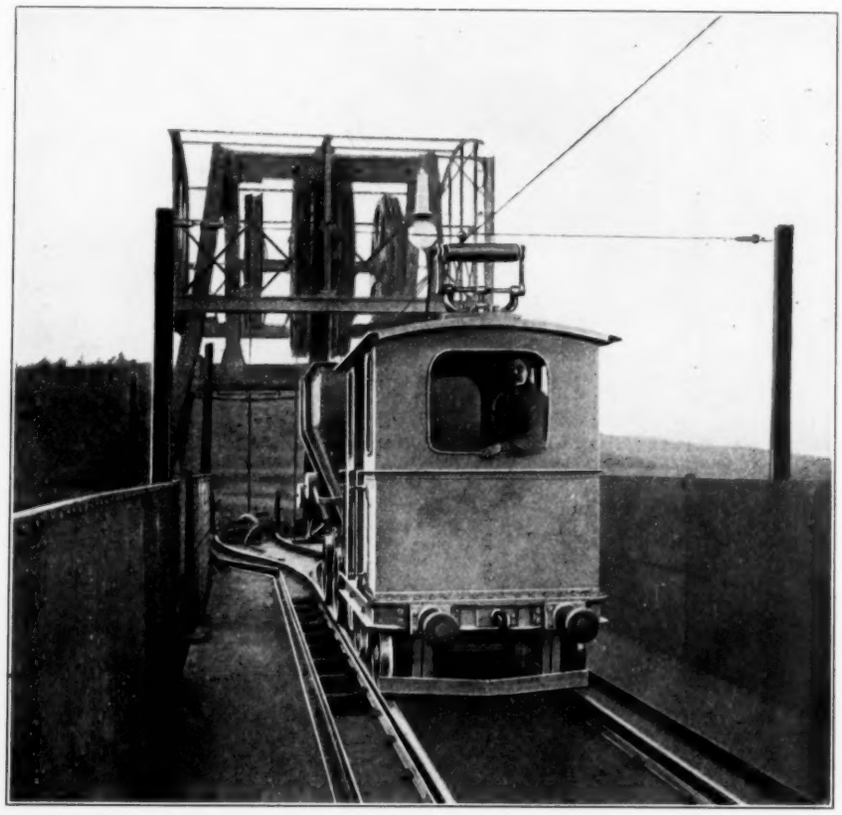


FIG. 7. ELECTRIC LOCOMOTIVE FOR SERVING FURNACES.

The installation has worked to the complete satisfaction of the blast furnace company, so much so indeed that they have just ordered the necessary machinery for a considerable extension. They have found electric driving better than steam because there is no waste of power in the intervals while work is not being done by the locomotive, pumps, etc., while the generators are always ready at any moment to give their maximum output.

German Lathe Tool Tests.

BY R. GRIMSHAW.

At a meeting of the Hannover branch of the German Engineers' Society Mr. E. Körting, Jr., made some remarks on tests of lathe tools, made in the Körting shops. First, Böhler steel was used. With 15 meters (49.2 feet) turning speed per minute and 2 m/m (0.08 inch) feed, the lathes proved too weak and the skin of cast iron injured the tools, occasioning much loss of time.

With Krupp's steel a large lathe with direct electric drive and speed variation enabled four tools to work at once on a flywheel; but with the belt-driven lathes new countershafting and gearing were necessary.

In the meantime there appeared the new "rapid" tool steel at a not prohibitory price, and which could be worked and hardened by the customer.

The steel is heated white and cooled in an air blast. Good results were obtained, naturally considering the machine tools and the castings not up to what the steel makers promised. The former speeds of 5 to 6 meters (16.4 to 19.7 feet) could be increased to 10 to 12 meters (32.8 to 39.4 feet), and the feed from between 0.5 and 0.1 m/m (0.02 to 0.04 inch) to between 1.3 and 1.8 m/m (0.05 to 0.7 inch). For instance, with a flywheel 5.28 meters (17.3 feet) in diameter and 500 m/m (19.6 inches) face, with about 15 square meters (161.5 square feet) surface to be turned, there was a time saving of 48 working hours; with a crankshaft about 3 meters (9.84 feet) long and 250 m/m (9.84 inches) average diameter, 10 hours; in planing the cheeks of the same shaft, about 9 hours. To test the limits of capacity of the various kinds of steel, there were em-

ployed a heavy shaper and the above-named face-lathe.

There were tested a tool of ordinary steel, a self-hardening "natural" steel, especially suited for hard cast iron, and three kinds of the "rapid" steel.

Tests were also made as to the necessary power required in the work. In running empty the power consumed was directly proportional to the speed. With 1,336 m/m (52 inches) and 12 m/m (0.47 inch) depth of cut, the power used was represented by a curve showing an increase with the speed.

From the speed and the work the pressure on the tool was calculated at 900 to 1,300 kilograms (1,980 to 2,860 pounds avoirdupois). A considerable number of tests with constant speed of cut of 14 meters (45.9 feet) and feed varying from 0.336 to 2.004 m/m (0.013 to 0.079 inch) showed that the power used was proportional to the feed. Lathes at present built could be run regularly up to only 10 meters (32.8 feet) per minute cutting speed; but special lathes are being built for the new steels.

Herr Brehpohl remarked that the new tools are good for cast iron and steel, but not for steel castings.

The Reid Gas Engine.

I found myself in Oil City, Pa., a short time ago, and naturally looked about a little for the source of the "Echoes from the Oil Country" that we have been hearing for some time. Having discovered that source, by a very natural transition my attention was directed to some echoes of a different kind, *i. e.*, the sharp bark of numerous gas engines being tested and also used in pumping oil from wells on "leases," as the tracts of land are called in that region which are leased by the man or company that produces the oil and who pays to the holder of the deed for the privilege; most of the land being practically worthless for any other purpose.

A gas engine is made and used here which I was told was regularly doing every day a lot of things that had been pronounced by high authorities to be impossible. This naturally aroused my curiosity a little, and I questioned my friend, the superintendent of the shop in which they are built, about them.

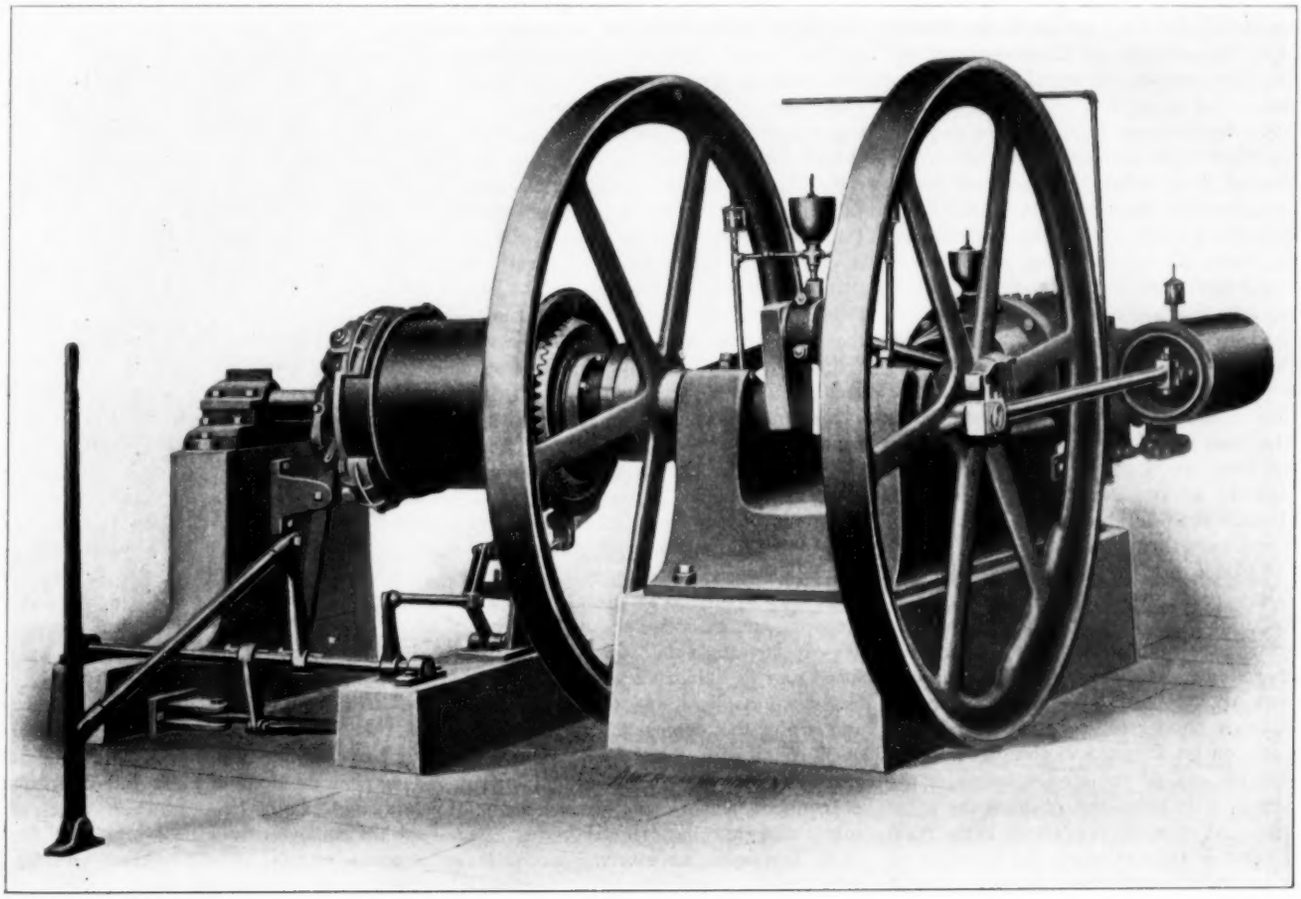
Others have referred in these columns to the very low cost at which oil-well pumping is done in Pennsylvania, and have described the appliances by which it is done. We here have some particulars about one of the engines that are doing this work. I saw numbers of them running with no one near them, and they habitually work through long periods of time with far less attention than would usually be considered absolutely essential for any gas engine.

The engine is a two-cycle machine with two cylinders, one of these being only for receiving and delivering the charge to the working cylinder. This form of engine was, I believe, invented by Dugald Clerk, the well-known English authority and writer on gas engines. He gave it up as impracticable, but might be greatly interested, I think, in seeing these engines, redesigned, running day in and day out, month after month, without a single stop for any purpose and giving entire satisfaction.

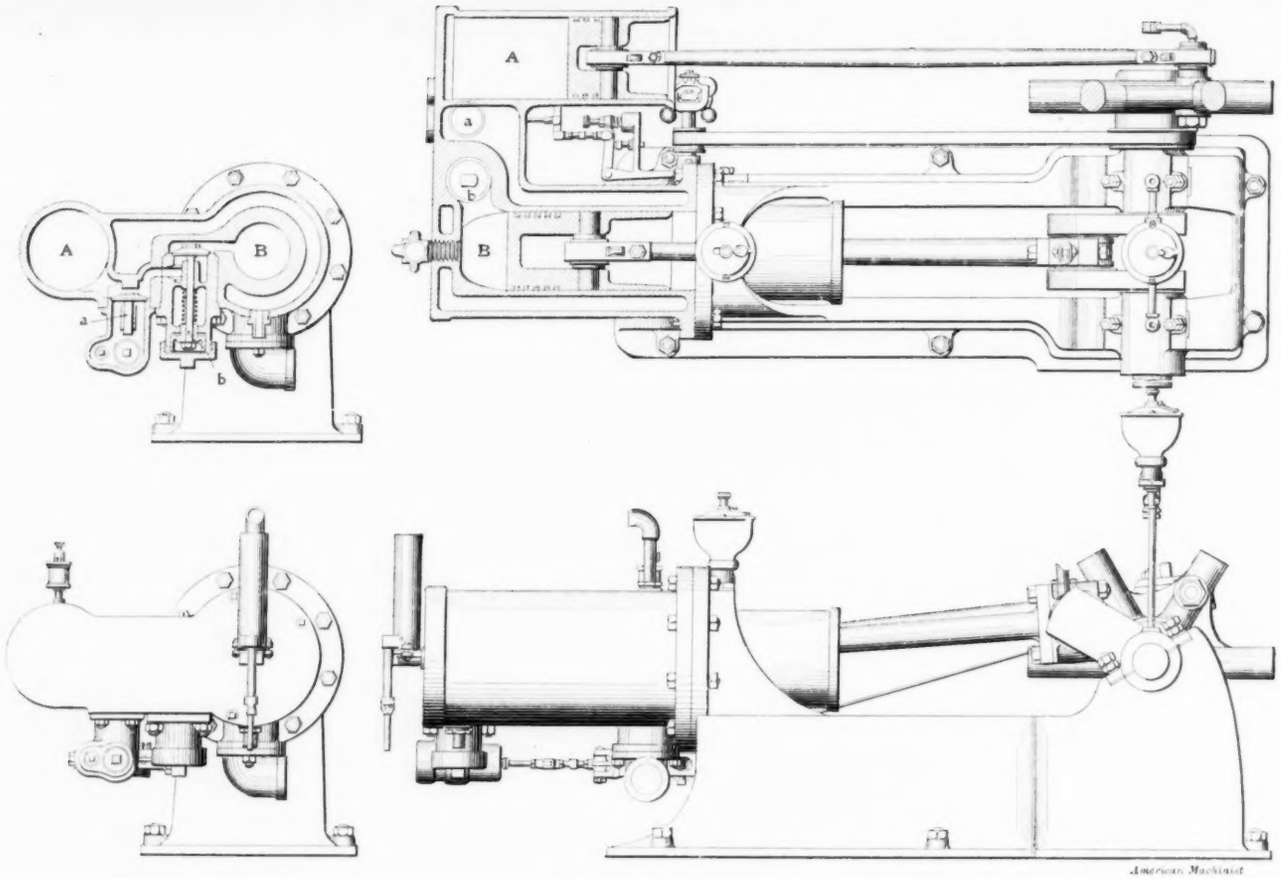
At Fig. 1 is a general view of the engine equipped for oil-well work, and Fig. 2 gives some elevations and sections that will be useful in studying the action of the engine.

It will be understood that this engine is of the two-cycle type and gets an explosion at each rotation. The charge passes into the first cylinder and is delivered by it into the second one, where it is compressed, exploded, and, after doing its work, exhausted.

The pumping of oil wells, while it does not demand an engine having qualities that unfit it for other service, does demand an engine having qualities not so vitally essential for other work. This engine is designed and built for use in the oil country, intended to be run by inexperienced people who usually give it little care or attention; to run for long periods without the necessity for stopping; to meet all reasonable demands for range of speed; to use natural gas as it is found at the



THE REID GAS ENGINE.



THE REID GAS ENGINE.

wells; to have as few parts as possible, and those of such form as to be readily duplicated in case of breakage, and so that they can be put in place with certainty.

The engines run under widely varying conditions as to fuel supply as well as of load and speed without alteration of parts; the same tube igniter, of the same length, being always used for the same size engine regardless of the conditions under which it is to work, and there is no timing valve. In fact, they set at defiance so many of the dearest traditions of the gas-engine business that the superintendent of the shop in which they are built said to me: "To enumerate all the points in which we have been told our engine was deficient would be to leave very little of it untouched; so you can believe it is some satisfaction to be able to sell them as we do and have them give satisfaction."

In Fig. 2, *A* is the charging cylinder and *B* the main or working cylinder. The charging piston, moving forward, draws in through the cylindrical valve a charge of air and gas which follows and fills the charging cylinder. While the charging piston is on the return stroke, the main piston on its forward motion, at an inch from the end of the stroke, uncovers the exhaust port holes and releases the spent gases. As soon as the pressure in the main cylinder is thus relieved, the pressure of the incoming charge raises the main valve *b* and the residue of the exploded gases, with all the impurities, is swept out through the ports before they are again covered on the return stroke of the main piston, thus securing a clean mixture and perfect combustion. When the charging piston has completed its return stroke, and the charge has been delivered to the main cylinder, the pressure holding the main valve open is removed and the spring (shown on the extension of the valve stem) draws the valve to its seat, the smaller plunger on the end of the valve stem preventing the forcible seating of the valve by the compression in the main cylinder. Wearing of the valve face and seat is thus prevented and the action of the valve can be inspected at any time while running by removing the cap. After the main valve has closed the return movement of the main piston compresses the charge and forces the combustible mixture into the ignition tube, producing an explosion and securing an impulse every revolution; which of course means that for a given amount of power the working cylinder can have half the capacity or that the speed may be half what would be required by an engine working on the Otto cycle, and while the explosions are more frequent than with that type, the time the gas and air are in contact is longer; this, in connection with the arrangement of valves and charging cylinder giving a perfectly homogeneous mixture in the main cylinder.

The cylindrical regulating valves for gas and air in the feed valve are attached by stems through brass bushings to a lever connected to regulating turnbuckle. Motion of the lever opens or closes both the regulating valves, increasing or reducing the size of the openings for gas and air, but not changing their relative proportions. The action of the governor, through the regulating turnbuckle, is to cut down or increase the quantity of the fresh charge forced into the main cylinder. The engine thus adapts itself to a very light load or to the full capacity of the engine, giving a light or heavy impulse as needed.

It will be noted that there is no exhaust valve and that the two admission valves are placed in independent valve cases and are operated by fresh, cool charges that pass through and take the heat from them. The springs used on the valves are not exposed to heat. In addition to this, the valve *b* is surrounded by a water jacket.

All the valves are of course automatic, except the governor valves, which are operated by a fly-ball governor and regulate the quantity of the mixture, giving a large or small charge as needed.

There is one peculiarity in the operation of the engine that is very useful in the kind of work it is designed for. Should it be running along at a fair rate of speed, carrying a full load, and an overload should come on, it will slow a little but continue to run; should the load still farther increase it will slow more, and should the extra load be removed it will recover

to its former speed without attention. By having the charge heavier on the slow than on the quick motion they get a certainty of action that enables them to handle the very unsteady loads that they have to deal with in pumping oil wells.

The range of speed the makers give for a 15 horse-power engine is from 120 to 200 turns, while the actual range through which the owners run them is from 72 to 320 turns without any change in parts.

By making the cylinders in one piece without heads all joints to give out and leak are avoided and the necessity of having to send to the shop for a man to pack a loose joint is done away with. The only joints to be packed are where the valve cases seat and only one of them has to withstand heat and pressure; it is packed with copper gaskets, and can be removed and replaced without disturbing them.

The oiling devices are simple, and that they are effective is proved by the engines being run in some cases for months without stopping.

It is hard to see how much cheaper power can be expected than what these engines furnish. Around Oil City, in 800-foot to 1,000-foot territory, they will pump wells with 2-inch tubing at a fuel cost of about 0.1 cent per hour each. A 15 horse-power engine has run 7 hours per day for 30 days for $3.60, pumping 13 wells; another one 26 days of 24 hours each for $23, pumping 38 wells. A 12 horse-power has run 305 days 24 hours each for $149.34, pumping 20 wells. A 20 horse-power ran 5 hours each week day, pumping 26 wells, and used less gas through the winter months than the pumper used in his stove at home, it averaging about $2.70, while he went to $3.50. In these cases they buy the gas, paying the same rate that the cities and villages do. In most cases, however, the fuel cost is nothing, as well gas is used.

The engines have not been in use long enough to know what to expect as to durability with good care, but one of them lately measured that had been in constant use for more than seven years, running from 10 to 12 hours per day, showed a difference of .005 inch in the main cylinder and .002 inch in the charging cylinder. The greatest enemies to durability seem to be the use of such water for cooling the cylinder as forms scale rapidly, and light, low fire-test oils for lubricating the cylinder. Every engineer that has ever had charge of a feed-water purifier will know the effect of passing water strongly impregnated with various minerals through the water jacket of a hard-working engine. To meet this condition, large hand hole plates have been placed on the top, bottom and end of the cylinders.

In Fig. 1 the engine is shown with a reverse-motion attachment, by which drilling and cleaning out wells is done as readily as with steam.

Though used mainly in the oil countries, their use has not been confined to pumping oil wells, but they are in use in many other places, furnishing power for a wide variety of purposes. They are made by the Joseph Reid Gas Engine Company, Oil City, Pa. F. J. M.

From the Note Book of a Cosmopolitan.

ONE THING ONLY—PROF. SWEET AND "HIS BOYS."

"Popcorn and popcorn only." Isn't this legend getting a little overdone. It gets on one's nerves and spoils the appetite. It is a sort of indirect assumption of mental and practical superiority over the ordinary poor mortal who likes to call himself an engineer, and who is obliged by force of circumstances to deal with more than "popcorn," either sweetened or unsweetened. What does it really imply, when you are button-holed, as it were, either by a catalog or an advertisement with this staring motto as the first claim to your attention. It has to me the symptoms of a little personal confidence, trotted out both before and after the real acquaintanceship is formed. "You are all right with us, you know, because we don't know anything about other matters in this world but popcorn, and you are quite safe with us. We can cure all your doubts and misgivings. Our whole mass of brain and muscular energy is devoted to popcorn and nothing else; and what is the result? You see for yourself. There can't be any mistake about us! It's popcorn and popcorn only! We don't do anything but this—no, not for worlds!"

. . . . . .

Now, this is the impression I get "before" going into details. But "after," it jars on me another way. "Now we have shown just how we make popcorn and popcorn only, several colors, sweet and unsweet—but only popcorn. You see the great risk that you would run by talking to one of those fellows who dilute their brains by making candy at the same time! Why, it isn't human nature to think that it can be did. You stick to us! You can't get anything else out of us, whatever you do, but popcorn; but this proves it must be the best and only kind that is any good."

. . . . . .

There Mr. Editor, I have had my grumble, and feel better. But, seriously, this motto for American manufacturers is not *"une grande reclame"* abroad, because it is not exactly understood as duly set forth above. Our Messrs. Sellers, Bement, Brown & Sharpe, Pratt & Whitney and other world-known firms who do make more than one style of "popcorn" are the practical engineers who have created the great appreciation for the diversity of American engineering. Perhaps this "popcorn" specialty is only one of the passing "modes," and will be dropped when the time is ripe. When I am traveling in England and over the continent, I object to being classed with those people of large conceit who make "popcorn, and popcorn only."

. . . . . .

What a delightful paragraph that was about the dinner to Prof. Sweet. I read it over with my breakfast, and enjoyed my food more than I had for a long time. But why were we not *all* there? Who are these youngsters who call themselves the Professor's "boys," and go clandestinely to work not only to deceive the generous and noble-minded Professor, but "freeze" the rest of us all out, and who get the Professor in a corner in your village and surround him with devotees. I object to this "exclusiveness" in a free country—not on the grounds that I am a "boy," but I feel, like many other workers in this country, that we owe so much to Professor Sweet and his delightful character, good example and teachings, that we are, many of us, his "boys," although perhaps distinctly competing with the Professor in the matter of years.

. . . . . .

We ought to bear in mind, in paying our homage to Professor Sweet, that a few years ago he was temporarily under a cloud that gave him a good deal of unmerited anxiety. His nature is one of the most sensitive, and he felt the unkind words that came out from under the cover of "spread-eagleism" some years since, when the Professor—high-minded enthusiast after truth that he is—dared to tell us of engineering advances being made in other countries. I said at the time, "They won't stand it, Professor," and they didn't, as you will remember. Many of our backwoods engineers, with a sublime ignorance that there were workshops in the "effete monarchies of Europe," pitched into the Professor with a rancor that was evidently straight from the head, if not from the shoulder. The Professor thought he was going to push us ahead a little, and give us some encouragement to do better in some things. He told of methods in continental foundry work, of finish on engines, the whys and wherefores of English machine tools, locomotives, and in many ways gave strong evidence that he, for one, did not believe that we had all the good things in machinery, and a little left over.

. . . . . .

I had some "pilgrimages" with the Professor on several occasions when we met abroad, and the results of these frequently appeared in your columns. The truth and real cause for the state of things as he found them, was the prime thought with him. He forgot whether it was a beef-eating English workman or sourkrout-consuming Deutcher that was responsible for a result that pleased him and which showed skill. It was engineering skill; that was enough. And with this appreciation fresh in his mind he had the bad taste to go and sit down, tired and really worn out as he was, and try to give us all

a friendly push to better things. No, we can stand a lot, but not from candid friends of this kind.

. . . . . .

It just occurs to me, after finishing the above paragraph, that you yourself, Mr. Editor, stand guilty, through your public confessions in these columns, of very much the same sort of indiscretion in writing of foreign practice in some of their better machine shops. But I remember you wrapped it up in different kind of paper and string, and you escaped—whether deservedly or not, you know best.

The Position of the United States in the Production and Utilization of Electric Power.*

BY SIDNEY GRAVES KOON.

That the United States should lead the world in the utilization of electric power for tractive, lighting and general power purposes, is matter for congratulation, though not for surprise; but the extent which our superiority in this respect has now attained is not generally recognized.

Fig. 1 shows the total electrical power available in France, Germany, Great Britain and the United States, as well as in such groups as the European continent, the whole of Europe and the world outside of the United States, at the beginning of the current year. In each instance the portion cross-hatched diagonally represents, to an appropriate scale, the electrical power available for lighting and power purposes, while the horizontally hatched areas represent the tractive power. The latter are shown separately, in the upper half of the space devoted to each political or geographical division; and again, in the lower half, they are shown, added to the remainder of the electrical power, thus giving a ready comparison of the totals. This shows the United States to have more than twice as much electric power available for use as all the rest of the world beside. Indeed, our figures for tractive power alone will closely rival the *total* for the outside world, and are far ahead of continental Europe. The backward position of France is cause for comment. Development in that country seems to be very slow. The new plant of the Manhattan Elevated Railway Company, of New York city, which is rapidly approaching completion, will have a power, wholly available for traction, of 40,000 kilowatts, or nearly double the total electrical power available for traction purposes in France at the present day. The power-house of the New York Edison Company will generate about 55,000 kilowatts, these two together having a capacity just about equal to that found in the whole of France. If we take New York city as a unit, the total power now available, or shortly so to be, will approximate to that at present found in the Empire of Germany. It is only fair to remark, however, that large plants are

* From the Sibley Journal of Mechanical Engineering. The diagrams are based on tables published in the *Engineering Magazine*.

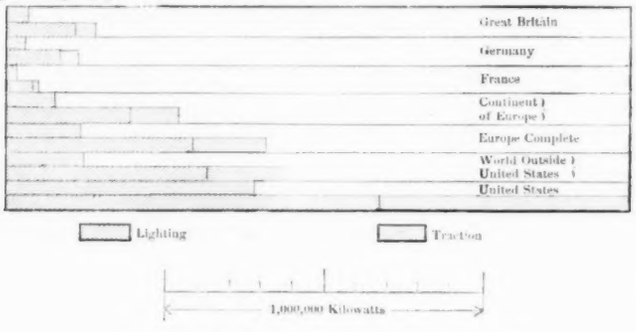


FIG. 1 ELECTRICAL POWER AVAILABLE IN VARIOUS COUNTRIES.

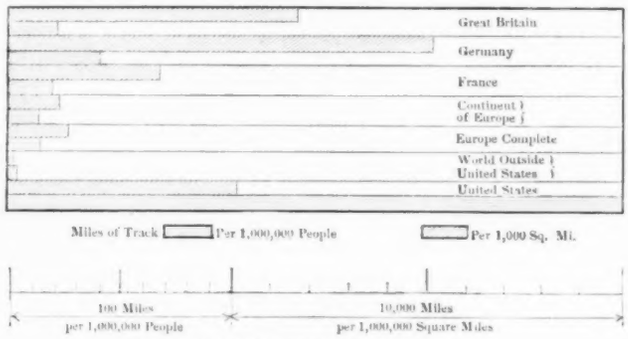


FIG. 4 MILEAGE OF TRACK COMPARED WITH POPULATION AND AREA.

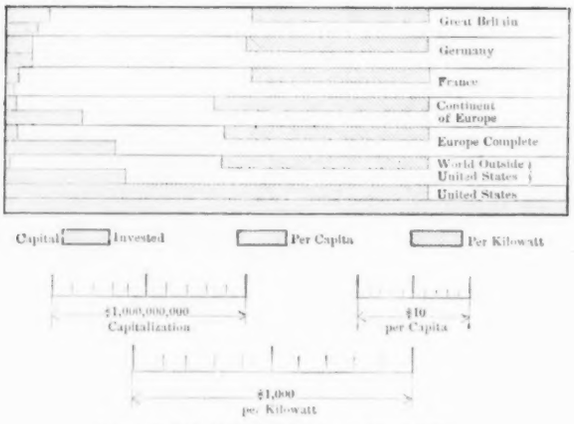


FIG. 2 CAPITALIZATION IN GROS, PER CAPITA AND PER KILOWATT.

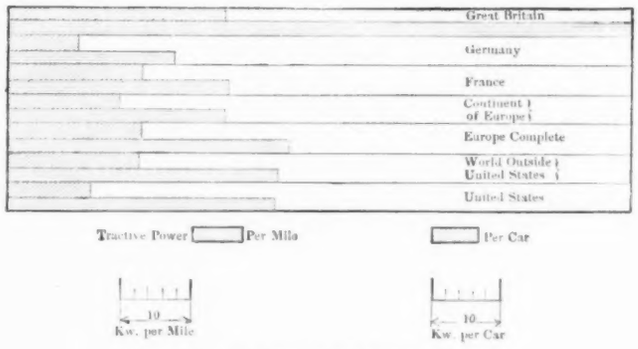


FIG. 5 AVAILABLE POWER PER CAR AND PER MILE OF TRACK.

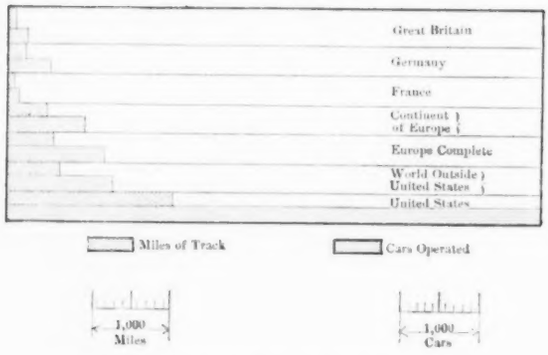


FIG. 3 MILES OF SINGLE TRACK AND MOTOR CARS.

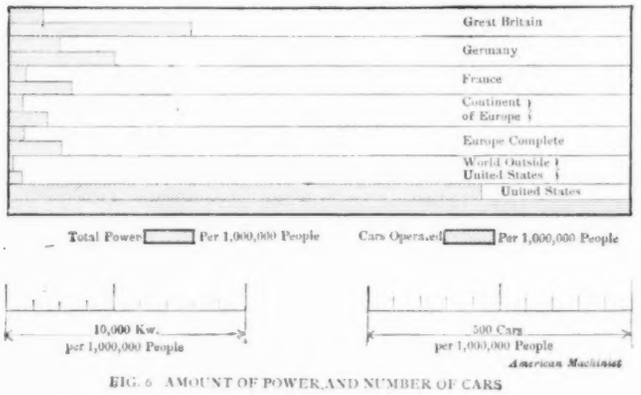


FIG. 6 AMOUNT OF POWER AND NUMBER OF CARS COMPARED WITH POPULATION.

under construction on the other side, as well as in this country; the 50,000-kilowatt plant in London, mentioned in the February *Sibley Journal*, page 218, is a notable example. These individual instances are brought forward, not so much to show what is being done in this line at the present time, as to indicate the magnitude which single plants may attain, in comparison with the enire output of some of the most progressive of European nations.

Fig. 2 shows the capital invested in the production of electrical power; it also shows the relation which this capital bears to the populations of the various countries, and the "intensity" of capitalization per unit of power output. The capital per capita, as shown for the whole world, is a meaningless figure, for there are, of course, included in the population on which it is based, several hundreds of millions of people to whom electrical power is an unheard of and unimaginable entity. For the United States, the capital invested is seen to be nearly five times that of the rest of the world and fifty times that of France, which has one-half our population. The per capita capitalization is here also at a maximum; Great Britain, our nearest rival in this respect, has a figure only one-ninth that which represents us. In the case of the United States, the hatched area representing the capital per capita is made to do a double duty, serving also for the capital per kilowatt generated. This latter is seen to be about double the corresponding figures for the other nations, which have each about equal values. This is largely attributable to the higher prices, particularly those for labor, which prevail in the United States.

Fig. 3 shows the number of miles of single track, electrically equipped, and the number of motor cars operated on such track. Our superiority is such as to make comment superfluous.

Fig. 4 gives some interesting results. It shows that while, per 1,000,000 people, our trolley track is *far* ahead of that of any other country, yet the restricted areas of Germany and Great Britain, when compared with their dense populations, are sufficiently small to cause their mileage per unit of *area* to exceed ours by a very considerable amount. Our enormous extent of area brings this figure below what other conditions would indicate. The long reaches of the Russian empire exert a similar influence on the mileage per square mile on the European continent. Here, again, the mileage ratios for the world at large have no significance.

Fig. 5 enters into another phase of the subject, and one more in accordance with pure engineering. It shows the amount of power available for traction for every mile of track operated by electricity, and for every car so operated. The extreme density of the population and the short runs made in England would perhaps account, by virtue of the heavy traffic incident to the same, for the great superiority possessed by Great Britain in power output per mile of track. Germany here stands lowest, a fact which would scarcely have been anticipated. As to the power per car operated, Germany is again at the bottom of the list, with the United States next. This is the more surprising when viewed in the light of the now well-recognized fact of the increased economy resulting from the operation of large units, be they steam engines, or trains, or ships, or even corporations. Yet these two nations are perhaps, from an engineering standpoint, the most progressive on the face of the globe.

Fig. 6 deals with two quantities: the total available electric power compared with population, and the number of trolley cars operated per million people. Here, as twice before, the figures for the world at large may be ignored, as having no value. The United States has an enormous lead in both particulars. The relatively low value for the number of motor cars per unit of population in Great Britain may perhaps aid in explaining the preponderance held by that nation in tractive power per car; the operation of heavy trains of trailers behind each motor car is there common practice.

In conclusion, it is exceedingly gratifying to be able to point to the enormous preponderance of the United States, in every department of this, a great engineering field of the future. We have 69 per cent. of all the electrical power available in the world; 76 per cent. of all that portion of it available for traction; 82 per cent. of all the capital invested in the production of electrical power; 76½ per cent. of all the electric railway mileage, and 83½ per cent. of all the trolley cars.

Graphite as a Cylinder Lubricant.

Cylinder lubrication, always important, is becoming serious. The tendency to the use of increased steam pressures and superheated steam, as well as the development of the gas engine, has caused consideration of two questions: What lubricant shall be used, and how shall it be used or "fed"? The many patent lubricators show that the latter question has received much study, but very little has been added to the choice of lubricants for many years. The effect of the use of graphite between rubbing surfaces is generally known. It coats metal surfaces with a smooth, protecting veneer of very low coefficient of friction. The fact that it does this within a very wide range of temperature makes it especially adapted to cylinder lubrication, for which its merits are well recognized, although it is but little used, because of its being troublesome to feed. In its dry form it can only be fed intermittently by hand, and when mixed with oil it soon settles, the results of the two methods being about equally unsatisfactory, and its use has hence been confined to emergencies or to special purposes.

Mr. W. F. Downs, of 75 Fairview avenue, Jersey City, who has been identified with graphite industries for many years, has recently applied an entirely new principle to the mixing of graphite with oil, which seems to solve the long-sought problem of making it remain in suspension. Two oils are used which, in the language of the chemist, are not miscible with each other—that is, they act toward one another as do oil and water. The graphite is thoroughly mixed with a small quantity of one of these oils—called the enveloping oil—the grinding being continued until each particle of graphite is coated with this oil, but with little or no surplus. The second oil is then added and the grinding is repeated until the graphite is thoroughly distributed through the mass. The effect is to make the graphite remain in practically perfect suspension.

The explanation of the action is obscure, but it probably has some relation to the action by which fog remains suspended in the air. So far as the force of gravity is concerned, the small globules of water of which fog is composed have the same preponderance over globules of air of the same size that larger masses have, and it is not at all clear why the fog remains suspended while larger masses do not, although the fact is patent to all. The same action is observed between water and finely divided solids. Solid powders remain suspended in water for periods depending on the size of their particles, and if very fine the period of suspension becomes almost indefinite. Gold in excessively fine powder, known as float gold, although nineteen times heavier than water, is the despair of miners, because it is impracticable to recover it by allowing it to settle, and, for the same reason, there is a well known and large loss of copper in the form of slimes which are nothing but extremely fine copper distributed through water. Whatever the explanation may be we have seen samples of this mixture of oil and graphite, in which the suspension seemed perfect after weeks of rest. The mixture has been found to feed successfully and without clogging in sight-feed lubricators, and it is altogether possible that the near future will see important changes in cylinder lubrication.

The Critic Criticised.

Prof. A. J. Du Bois answers in the *Railroad Gazette* of April 4 the criticisms of a reviewer of his work, "Mechanics of Engineering," and ends his letter with the following amusing parallel:

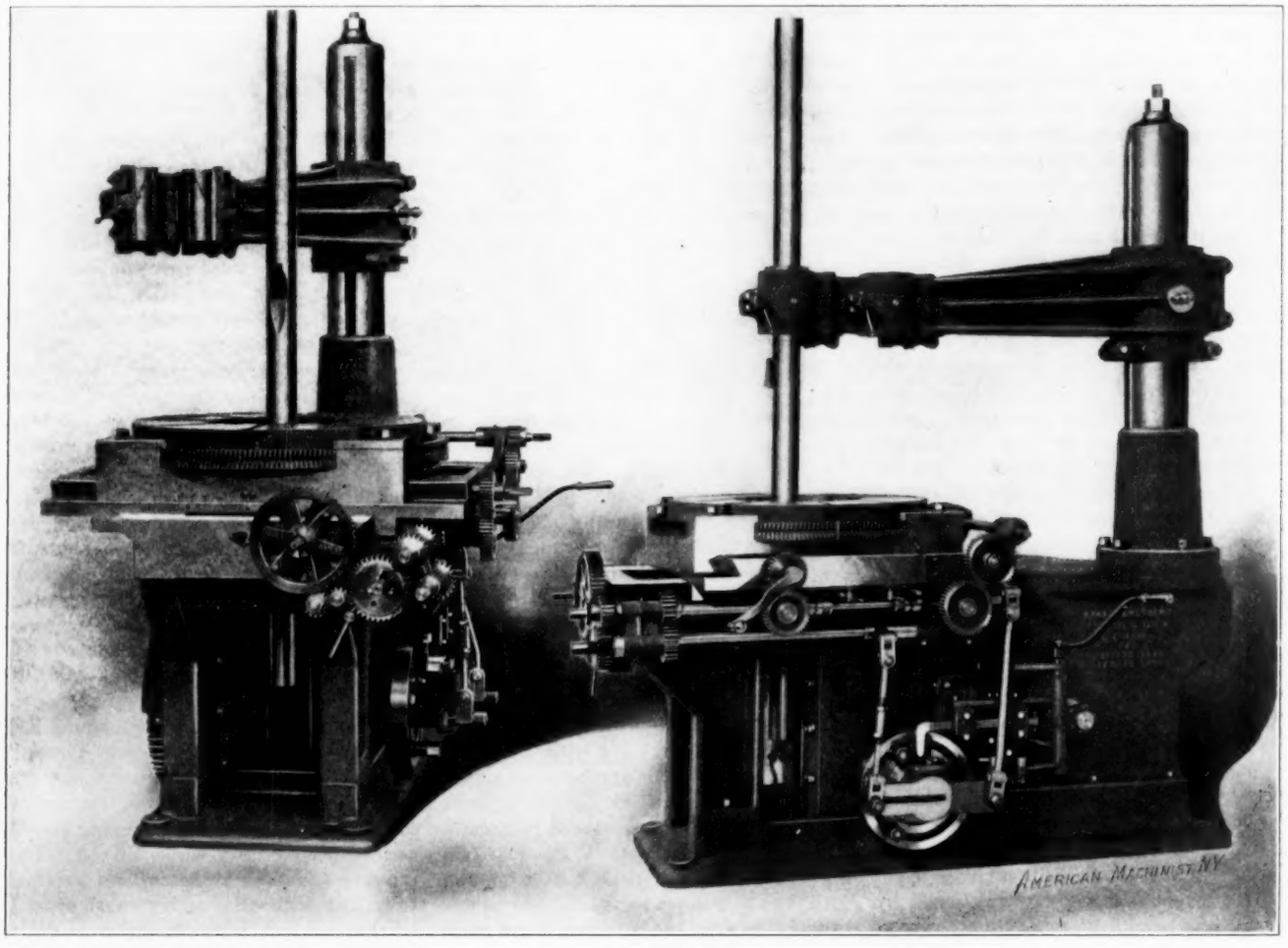
"Suppose you were to ask an expert opinion on a new make of bicycle, and should get something like the following: 'From an engineering point of view my opinion is not favorable. There are several rust spots on the rim. The spokes are in tension, which is contrary to the "usual practice" in ordinary cart wheels. Forward motion is produced by pedals, a prin-

ciple of "doubtful utility," because it is "applicable only" in cases where a crank is used. The maker states in a circular that a gallon of pure water weighs 10 pounds!'

"I leave it to your readers whether this is a parody or a parallel."

Draw Stroke Slotting Machine.

The half-tone herewith illustrates a draw stroke slotting machine built by Baker Bros., of Toledo, Ohio. At page 186 we described an improved keyseating machine built by the same firm, and our readers will notice that this slotter contains practically all of the important features of the keyseater. The bed of the present machine has been extended in front, and on this bed is mounted a saddle carrying a compound table. All of the table feeds are automatic, the rock shaft by means of which the table is fed along the bed being operated by mechanism similar to that used on the keyseater. The rock shaft drives another shaft mounted just above it, and this shaft operates the cross feed and rotary feed for the circular table. The table is 38½ inches in diameter and has an opening 20 inches across. The cutter bar is supported at the top and bottom, and is backed up in the middle, when cutting, by a bronze shoe. This bar has a cutting stroke of 20 inches. On the up-stroke of the cutter bar an automatic relieving device withdraws the work from the tool. Another type of this machine is made with forward and back feed only. This machine has a long, narrow opening in the work table, and is built for machining long, narrow slots.



DRAW STROKE SLOTTING MACHINE.

Echoes From the Oil Country.

STRAIGHTENING BY PEENING.

When I first got interested in the gentle art of peening I exercised my skill on various pieces gathered from the scrap heap, and as I learned to make them to some extent take the forms I desired I imagined that peening would have innumerable uses. I could hardly wait until noon to work on the old piston ring I was trying to peen straight. I never was quite satisfied with my performance, as I never got one straight, although I got some out to quite an extent. While I got them nearer straight than one other chap that was trying, "Old Jake" got one straighter than I did, and he said he could get it entirely straight if he had time. However, he taught me enough for a start, and a little book on the trade which I invested the savings from my apprentice wages in soon afterward gave me some more ideas that confirmed me in the habit of using the peening trick as I had opportunity. It seems strange to me that I have not seen it used more, but in my experience I have seen it used very little, yet I find it very often a great labor-saver. Perhaps that is why I like it so well.

Shortly after going to work in a new shop a saw frame was brought in for repairs that had been through a fire, and I was directed to take it apart. It was made of cast iron, and one side, 6 or 7 feet long and about 8 inches deep and ⅝ inch thick, was badly warped, although otherwise sound. I sized it up for a nice piece to try my art on, and as the boss came around I struck him with: "Say, what are you going to do with this side?" "Guess I'll have to have a pattern made and a new one cast and fitted up," said he. "Why?" "Oh, nothing much," said I. "I thought maybe you would have it straightened." "Do you know it's cast iron?" he asked. I nodded. He looked me over for a minute with a rather humorous twinkle on his face and then he said: "Where are you from, anyhow?"

"Oil Country," said I. "Oh—, well, all right, I've been looking for you. We were going to shut down to-morrow to repair

the boilers, so you can have the whole shop and blacksmith shop. I want you to come in and straighten it up. How much help will you need?"

"One helper that will do just as I tell him will be enough, and I'll be here at seven o'clock," I said. And so I was in for it.

Presently one of the helpers, a large, good-natured man came over with a broad smile on his face with: "Say, neighbor, the boss is kind of putting you into a corner, isn't he?"

"I don't know—why?" said I. "He told me to come in to-morrow and do whatever you said. That you were green enough to think you could straighten the side of that saw frame, and he was just sporty enough to want to see you do it or squeal. How is it now, do you want me? I don't believe he expects either of us to show up." And he looked at me with a grin.

I looked over at the frame. The side was nearly like an I-beam in section, and was out in several directions, but it seemed more of a twist than anything else, although it did look tough; but whether I could straighten it or not remained to be seen. Looking up, I saw several men watching me and I knew that they were all posted. There was only one thing for it: I would either straighten it or bust—it or myself.

"You be here in the morning and we'll fix her," I said, trying to speak as though it was the most commonplace job in the country.

"By gum, he says he's going to straighten it. I thought the boss was just joking," I heard him remark to a machinist near by as he walked past him.

As I went home that night I wondered if they discharged a man if he tried a job and got stuck, and I thought perhaps I had been a little hasty. The next morning I was glad we were alone in the shop. I had a small old anvil brought in from the blacksmith shop and set on a block, and then getting the side on it, with the helper holding it up as I told him, I began to tap, tap, tap along; you know how it's done, and I watched with anxious eye to see if it was really crawling the right way. How very slow it seems to go on a doubtful job, and how the arm will ache at first until it gets warmed up.

Yes, no doubt of it, she was straightening some. Now, I will try the flanges a little; pretty light, though, as it is a twist in them, a little inside here and a little outside there.

"Darned if this thing isn't getting straighter," burst out the helper, after we had been at work some time. "Maybe you do know enough to straighten it after all, and there may be some things them other fellows don't know." It was too early for me to do any talking, so I worked away, now tapping here a little, then there, and watching and measuring to make sure I was making it all go in the right direction.

The boss came in and watched us for some time without comment, but I judged it was a new wrinkle to him. Along in the afternoon it was so near straight that the rest of the machine pulled it into place nicely, and it was painted up and sent out.

I once had another job somewhat different but really easier. A side-draft engine had been through a fire and was brought in for repairs. The crank disk and shaft were of cast iron and both were badly sprung. They were a single casting, and it looked a good bit like a new one for it. After the owner of the engine and the boss had talked a while, it was decided to turn the shaft down about ¼ inch (it was 4⅜ inches diameter), bush the eccentrics, flywheel and pulley, take out the crank-pin and true the hole out in line with the shaft and put in a new pin.

It was told to go ahead with it on those lines. The disk was out so much that I could not face it off true, and I would have to work entirely from the shaft. The bearings were smaller than the balance of the shaft and—well, that flywheel was too large to bore out handy and a bushing would have to be thin unless it was bored, and so many bushings were expensive anyhow on a repair job.

An idea struck me, and I offered to straighten the shaft and disk if the owner wouldn't kick on the hammer marks. After talking a few minutes I was told to go ahead if I could make a job that way. The shaft was in the lathe, and I soon found the high spot and turned it so that it came on the under side, and then I had a boy pulling down on a bar that rested over the tool carriage and prying up on it, while I began putting nice little marks all over the low spot with the peen of my hammer. When I had got several inches of it as full of marks as it would hold for about one-third of the circumference, I would take the face of the hammer and pound them out, and so make it look a little better and stretch it a little at the same time.

It didn't take long to get that shaft so that the chalk touched on the side with the hammer marks on. I let it go at that, as I expected it would crawl back some, and then I tried the disk. That was harder to do, and I had both inside and outside pretty liberally ornamented with hammer marks before I got it up where it belonged. That didn't matter, though, as I had escaped making those bushings and that wrist pin.

I did not turn the bearings, as they were round—only polished them, and then gave the crank-pin a rub by hand. That engine was used within a few miles of the shop, and I often saw the man who had it, and know it never gave any trouble.

Persons trying to do a job of this kind for the first time should go very carefully and gage the effect, as they are apt to find they are going just the wrong way. They need not be greatly discouraged if they do, for they will not be the first ones to do so.

The job on the engine was the means of my being sent to a large sawmill to straighten their line shaft. The owner was getting some work done and inquired if we could straighten his line shaft if he sent it down, remarking that he "hated to take it out, it was so heavy and awkward to handle." The story of the engine crank was told to him and he came and had a talk with me with the result that I undertook to save him the bother of taking the shaft out.

I found the bend a beautiful one; long, easy and graceful, away from the bearings and only one pulley to bother, and that one easy to move. The head sawyer and another man, a big fellow about six feet two or three inches tall, were there to help me. They had also a good heavy sledge and a lever big enough to raise a corner of the mill. I took in the situation and was impressed with the humor of it. Evidently the owner was rather hazy as to his ideas of how I intended to straighten that shaft, or else he had not conveyed his ideas to his men with much clearness.

After moving the pulley out of the way, I had the shaft turned around until I got some chalk marks to show just how the bend was, and had the lever put under and just enough weight put on to hold the shaft taut. As the head sawyer bore down on the lever the other man reached and picked up the sledge. I paid no attention but began peening along until I thought it time to try what effect it was having and found it was very little. "It's going to take quite a little work to bring that to place," I remarked as I settled down for another course. Chancing to glance up, I saw some thought transmission and pantomime going on above me that spoke as plain as words their opinions of a man who didn't know any better than to waste time tapping on a shaft when there was a good man and a sledge waiting to do some good. It was so amusing that I had hard work keeping my face straight, but did and said nothing. However, I kept the one man at the end of the lever and the other one at one side at a pulley where he could turn the shaft while I slowly drew it into place. I kept on until I had it slightly overdrawn, and then invited the sawyer to have a look at it.

The look of surprise that came over his face when he saw how it ran was rich. "Here, Jake, you have a look while I turn the wheel," was his only comment. Jake looked and then looked at me, and at my hammer and at the sawyer in a way that was too much for my gravity. I roared and was joined by both of them, although Jake appeared to be in doubt as to just what he was laughing at.

"Is that good enough to suit you?" I asked. "It is a good bit better than I ever expected to see it," the sawyer replied.

"As good as you expected?" I asked with a grin.

The two men looked at each other a little sheepishly, and the sawyer spoke up: "I guess we might as well own up. We neither of us thought you could do any good with that little hammer, and besides that if it did have any effect you were hitting on the wrong side as we saw it." That was the message I had intercepted during their wireless telegraphing. I tried to explain that I was not bending the iron as the term is usually understood, but causing it to bend by gradually stretching one side.

They are not always as silent in expressing their opinions in some places as these two men were. Over at the organ works they had a flywheel that was out about ¼ inch sideways, and shook things so as to cause serious trouble. They had tried to straighten it by sledging the arms, and some bright genius had even stoved up one side of the end of the shaft, trying to give it a tip. All the good it had done was to make it nearly impossible to get the wheel off. I wasn't wanting it off myself. I wasn't sent there to fix the wheel either. Some chance remark as to the building shaking led up to it and the "Old Man" came up and asked me out to see it run.

"Can that be straightened?" he asked.

"I think so," I said.

"Well," said he, "if I were a machinist and was around where a thing ran like that and it could be fixed I would die before I would leave without fixing it."

As I didn't see the need of dying over a little job like that, and as it looked as though fixing it might keep someone else from dying too soon, I told him to shut down and I would see what I could do. Shutting down brought the whole force into the engine-room. I wanted only one man and used him to hold a piece of iron on the arm, to give me a little more solid place to strike on. The shape of the arms was such that I could not get close to the hub to do the stretching, but had to work well out; this of course made the progress slower than ordinary, and every man there seemed to have something smart to say about the fool notions of the different fellows that tried to straighten that wheel had, and as to whether they would need straps to hold them to their machines on the morrow, and so on. I was too busy to talk, and that wheel went so slowly that I began to fear that I would not get a good job. I did not know enough then to examine the wheel for dish and to take advantage of any there was in the arms to help me.

It took several hours' work to bring that wheel into line, and there wasn't much surface on one side of some of the arms that didn't have hammer marks on. The engine ran without shaking the factory when I finally got through, and the Old Man's "You look like a man that could straighten that wheel if anyone could, I knew that as soon as I saw you," made up for some of the left-handed compliments paid me by the others.

W. OSBORNE.

Foreign Markets for American Machinery.

PEAT PRESSES FOR RUSSIA.

There is now an opening in Russia for peat presses. The increasing consumption of this substitute for wood in so many parts of the country has caused a great demand in many districts for machines in which peat can be compressed into fairly small blocks. At present a very primitive sort of native appliance is in use. They are constructed almost entirely of wood and are worked by hand, the peat blocks being simply pressed by means of a long and heavy wooden lever. It will readily be understood that the results are quite elementary and it ought not to be a difficult matter to put before the Russian buyers a cheap, portable and handy appliance for dealing effectively with these peat blocks. Quite a large trade could be done with the right sort of machine.

COFFEE MILLS FOR RUSSIA.

A change has come over the habits of the Russian coffee drinkers and has caused a demand for a new kind of hand mill in which the berries are ground as fine as possible. Under this new method the coffee is not strained, but the impalpable powder remains in the beverage, as it does when made in the Turkish style. The Germans have already seized the opportunity and are exporting coffee mills like those used in Turkey to various parts of the Russian Empire.

APPARATUS FOR REMOVING TREE STUMPS.

A simple, effective and fairly cheap appliance is wanted in Russia for removing tree stumps from the ground. There are none on the market that quite meet requirements. An apparatus (sent by a German firm) worked by pulleys, by means of which the stump is dragged out of the earth, has been used, but it is too expensive and also too complicated for the peasantry.

BRIQUETTE MACHINERY.

There is likely to be a demand in Victoria, Australia, for briquette machinery. A proposal is being made to work certain beds of lignite in that colony, and a syndicate has already decided to work the Morwell mines, reputed to be the richest in Australia. The idea is to make briquettes from the lignite.

OPENINGS IN BRAZIL.

British manufacturers of machinery are on the alert for orders from several Brazilian enterprises. For instance, a narrow-gage railway is to be built from Tabua to the junction of San Manoel and Tapajoz rivers. Mr. J. Baptista, A, Filho, of Cuyaba, has the undertaking in hand. Another is a narrow-gage line of railway from Araraquara San José de Preto to Cuyaba (the Companha do Estrado do Ferro de Araraquara San José de Preto, of Sao Paulo). A third undertaking is under the control of M. Achillo Souza, of Buenos Ayres, while a telephone service is to be inaugurated at Cuyaba, M. Pedro Joao Dias, of Cuyaba, having all contracts in hand. These different concessions can hardly fail to lead to important orders of machinery. It is found that if the sugar industry of Brazil is to prove reunerative the planters must use the best of modern machinery. At present there are innumerable small sugar mills in the country and each planter runs his concern in his own way—which is generally a very rough-and-ready one. It is being suggested that those in each district should combine and form one large mill with the latest machinery, and by so doing make a paying concern of it. If any United States exporter of sugar machinery were to make further inquiries at Sergipe, Brazil, it might lead to business.

THE CHINA TRADE.

The chief users of machine tools in China are the several dock and railway companies, also the government arsenals. The Hong Kong & Whampoa Dock Company has three large dry-docks and one large workshop in which all the modern tools are used. At present this company buys its tools and machinery from England. The pumps and hydraulic machinery used in the Hong Kong water works are of British make, the water-works system being controlled by the government. Power pumps are used for pumping out the docks and some small ones are employed on board vessels. It i likely that with the opening of the Kowloon extension there may be a demand for pumps and hydraulic machinery, as well as other supplies.

RUSSIAN EXPOSITION.

By the way, I may mention that there is to be held a very good industrial and technical exposition at Vilna, Poland, between the 13th and the 21st of September next. When the Russo-German Treaty ends in 1903, Russia will have to look out for new markets which will supply her with machinery of various kinds, which she has largely imported from Germany. Now I may remark that American firms have a very good idea of the position and are determined to replace Germany as much as possible. In view of future events and competition, some of the American exporting firms might like to make a show at the exposition. I suggest that they write to the United States Consul at Warsaw, Poland, who will have all the necessary facts.

F. C. C.

London.

A Gas Engine Started by Pressing a Button.

One of the outside men came into the office of a gas-engine concern on whose payroll his name was inscribed, and said he to the superintendent: "Our competitors at the other end of town have devised

an improvement which is going to knock us out of the gas-engine business; they start their new engines in a way that is so astonishingly easy that it is going to take like wild fire, and as I understand they have a patent on the method it will be impossible for us to use it and we must begin looking for something else to build. Nobody will buy our gas engines that have to be started by taking hold of the fly-wheel arms and pulling them around one way or the other to get an explosion."

Said the boss: "Now, how do our friends start their engine?"

"Why, they simply press a push-button and the engine just starts."

"Well, don't they do anything else to it?"

"No, that's all they do. They simply press the push-button and the engine starts."

"Well, now, you have been in the business for quite a while and you ought to know that the mere pressing of a push-button will not start an engine; that something else has to be done to it either at the time or previously, because the energy necessary to compress the charge and to start an engine cannot come from nothing and it cannot come from the mere pressing of a push-button. Something else is done to it. We don't know now and perhaps cannot readily find out what else it is that they do, but that they do something else may be depended upon, and I think you need lose no sleep in the meantime over this new invention."

A few days later the gossip of mechanical circles in that town conveyed the information that in starting one of these engines by the push-button method a considerable portion of the cylinder had been blown out and it was then revealed that the plan had been to insert in a removable plug a charge of gunpowder which was ignited by an electric spark produced by pushing the button. A little too much gunpowder has been used in this instance for the strength of the casting and as a result of the explosion in this case a man standing by was killed and the push-button-gunpowder combination was given up and gas engines are still started in that town by the arm-to-arm method as of yore.

A New Feed Gear Arrangement for the Lathe.

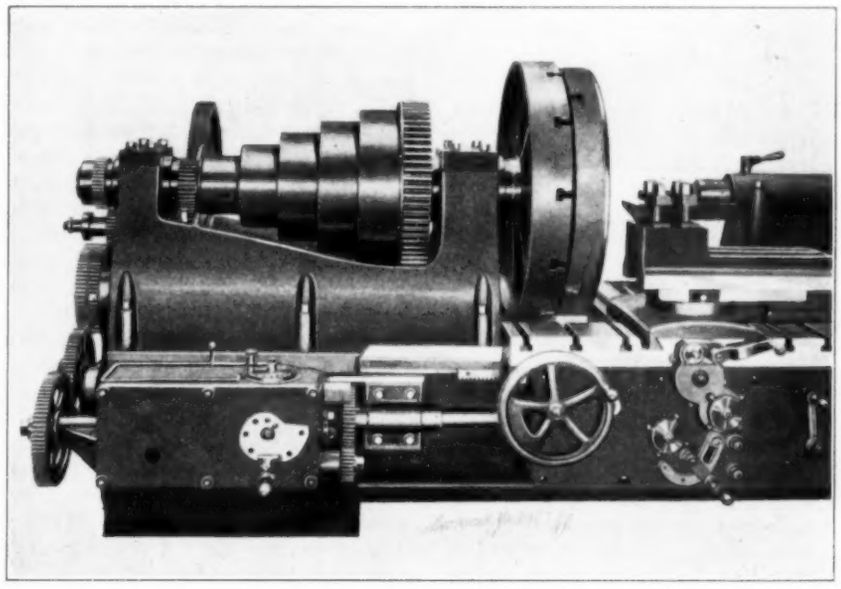
At page 1230, Vol. 24, we described a new arrangement of lathe feed gears brought out by Schumacher & Boye, of Cincinnati. The accompanying half-tone shows the gear box applied to their new 36-inch lathe. As most of our readers will recall the operation of this device, we will simply go over its principal features without showing again the detail of construction.

The shaft for driving the mechanism in the gear box projects at the left, and is driven by means of the gear train from the live spindle of the lathe. This driving shaft carries inside of the gear box a spur gear, which can be moved endwise within certain limits but which must revolve with the shaft.

Directly below this driving shaft is a short shaft carrying a nest of eight gears, and having on its outer end a spur gear which drives the lead screw. This shaft, with its several gears, is mounted in a swinging frame pivoted on a stud which is in line with the lead screw. The frame with its gearing is swung up into place or dropped out of the way by means of the lever shown in the front.

The sliding gear on the driving shaft is brought into line with any one of the eight change gears by a yoke and a rack operated by a spur gear. This gear is mounted on a vertical shaft and turned by the crank shown at the top of the box.

The index plate under the crank has eight holes, corresponding to as many different positions of the driving gear on its shaft.



A NEW FEED GEAR FOR THE LATHE.

The locking pin carried by the crank is dropped into the proper hole in the plate, and the gear is thus held in position.

At the bottom of the shaft rotated by the crank is fitted a bevel gear which meshes with another gear and turns the index plate shown at the front of the box.

In order that any one of the eight change gears may mesh properly with the driver, it is evident that the frame carrying these gears must be arranged so it can be swung up and held in any one of eight positions. This is accomplished by making the index plate in front scroll shaped, the holes for receiving the lever locking-pin all being at different distances from the center.

Eight changes of feed are given by this gear box, but the number may be multiplied by changing the gears outside of the box.

Three Small Jigs.

BY VER I. NIER.

As the subject of jigs seems to be receiving a good deal of attention at present, I wish to describe a few jigs which have come to my notice. These jigs are somewhat diminutive, compared with those recently described, but each one does its work thoroughly and well.

In the course of manufacturing certain novelties a great many small cubes of brass were needed, which were obtained by sawing square drawn brass rods to the desired length. The size of the cubes is shown by the dotted lines *a*, Fig. 1. Into each of four sides of this cube a hole was required nearly through the piece, the drill used being a No. 66 B. & S. gage. Each hole was in a different position on the cube. A piece of tool steel, 1¼ inches wide, ¾ inch thick and 2 inches long, was milled on all surfaces, it being finished as large as the steel would allow. The step *b* was milled ⅛ inch deep the entire width and at about the middle of the length. This block served as the base of the tool, and had two holes *e* to fasten the jig to the drill press table. A 5-16 inch hole was drilled in the face of base, near the end, and the stud *c* was fitted into same, the stud being fastened with pin *d* and having a slot *m* milled across the top. This base was hardened and the surface ground true. At *g* is a connection or hinge piece, made of a piece of ¼-inch Stubb's wire, flattened on one end to fit slot *m* and having a 3-16 inch hole drilled in the opposite end, half the length of connection. At *h* is a hinge pin on which *g* may be raised. The jig part *k* consisted of a piece of square steel, with one end turned to fit the hole in the connection. The opposite end was milled to bring all surfaces parallel with the part just turned and square

with each other. The bottom edge was milled off enough to allow for the plate *i* to be fitted and still retain the square. This plate consisted of a piece of flat tool steel, with a hinge on the top side which fitted a slot already milled in the main part of the jig. The square *a* was sunk into the block and was of suitable size to receive the little brass cubes. Handles *l* enable plate *i* to be opened and closed. When using the jig the plate *i* is turned to the top, the plate is raised by the handle, and a blank is placed in position. The plate is then lowered and held in position by pressing the two handles together while the hole is being drilled. The jig is turned from hole to hole by raising and turning it in the connection *g*, the operation being repeated until all four holes are drilled and the jig being pushed in or pulled out ¼ inch and to the desired depth. The movable part of the jig *e* had a spindle turned on one end to fit the hole *d*. The opposite end was milled 13-16 inch long, 5-16 inch wide and ¼ inch thick. Holes *f* were drilled with the movable part clamped tightly to the lower part. These holes served as starters for milling the forms *g* of the balls, which was done by the use of a ball reamer placed in the chuck of a speed lathe, the two pieces being pressed toward each other, while in their natural position, until the desired depth was obtained. The holes *h* were to allow the chips to fall out. Two balls were placed in position and clamped, and the hole *i* was drilled for the clamping cam *j*, which was made of a piece of ¼-inch steel rod turned to fit hole *i*, the end projecting ¼ inch for handle *k*. The center part of the deavor to outdo each other in price, as the work was piece work.

One specialty made in this shop required a number of brass rings, 1 inch outside and ¾ inch inside diameter, which contained five small holes in different positions. The rings were wound on an arbor similar to one for winding springs and were then numbered and sawed on both sides, thus cutting the rings into two parts. The base *a* of the jig was turned from 2-inch steel, the bottom part being ½ inch thick and the hub being 1 inch diameter and ⅛ inch long. Through this base was bored a hole *b* ⅝ inch in diameter. The second section extends from the bottom of the base up to the top of the ring, one end being turned to fit the hole in the base. The opposite end is turned 1 inch in diameter and ⅜ inch long, the groove *c* being

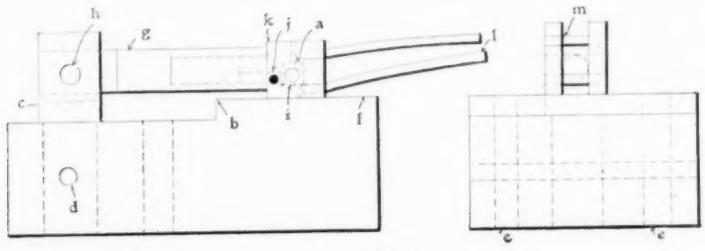
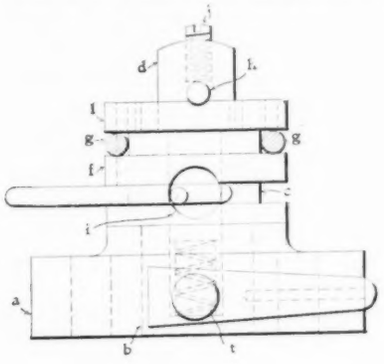


FIG. 1



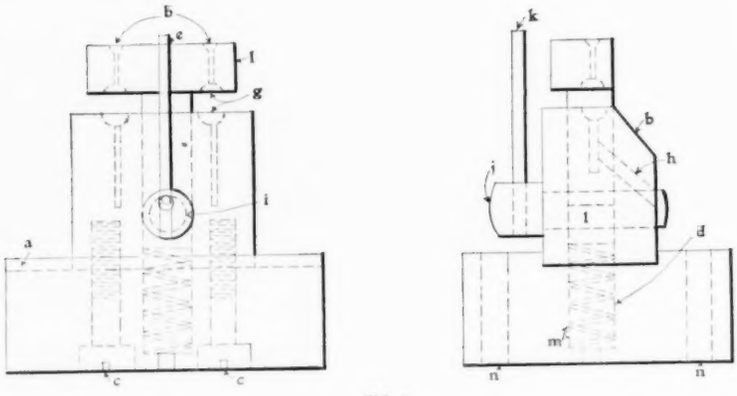


FIG. 2

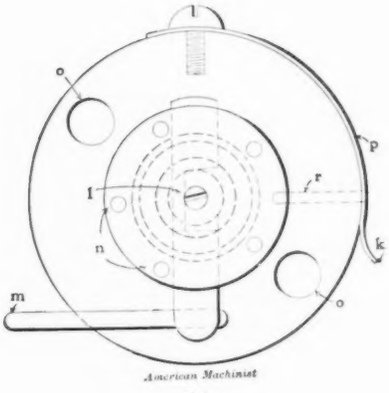


FIG. 3

THREE SMALL JIGS.

of connection *g* as the case may be, to bring the hole in line with the drill. This tool has been in use a long time and produces work at a very low cost.

Fig. 2 shows a jig for drilling and counterboring balls which were ¼ inch in diameter and were to be drilled through the center with a No. 59 twist drill and counterbored on one side. A piece of tool steel, 1¾x1½x⅝ inch, was milled on all surfaces and the groove *a* was milled the entire length. This piece served as the base of the tool. This piece *b*, 1 inch long, ⅞ inch high and ⅝ inch thick, was fitted into groove *a* and fastened by screws *c*. A hole *d* was drilled through the top piece and nearly through the base, this being accomplished by drilling a small hole the entire distance and then counterboring to cam was turned 1-16 inch diameter, as shown by dotted lines *l*. The spiral spring in hole *d* was for the purpose of forcing the movable part of jig upward, and it always kept the bottom of the hole in the spindle against the cam.

The counterboring jig differs slightly from the one shown in having a small pin projecting from the bottom, which fits the hole already drilled and serves to center the ball and bring the hole in the right position to be counterbored. Thousands of balls have already been drilled with this jig, which is still in use and does the work satisfactorily.

The jig shown in Fig. 3 was the outcome of a little competition between two employees of a certain shop, in the en- recessed to allow the chips made in drilling to fall out. The extreme top end of this part was turned ¾ inch in diameter to fit the hole in the ring and ⅛ inch long, the length being equal to the diameter of the wire in the ring. A hole, 5-16 inch in diameter was drilled from the top, as near through the piece as possible and leave a bottom. The top piece *d* was turned to fit the 5-16 inch hole in the lower part and to reach half-way through the lower part. The opposite end was turned 7-16 inch in diameter and ½ inch long. Washer *c*, the jig part of the tool, was made 1 inch in diameter and 3-16 inch thick. With a wire *g* in position the parts were clamped together and the pin hole *h* and the ¼-inch cam hole *i* were drilled, after which hole *h* was elongated, the adjusting screw

hole *j* was drilled and tapped and a groove for pin *h* was milled in washer *c*. The locking cam was similar to the one already described in connection with Fig. 2. The washer *c*, the jig proper, had five holes *n* and was hardened. Holes *o* in the base were to clamp the jig to the drill table. An index pin *r* and spring *p* completed the tool. In use the work is clamped by the handle *m*, and the jig ring *l* is raised clear of the work by the spring *t*. This jig has performed the work on thousands of rings, and as yet every one has been perfect.

The Responsibilities of the Educated Engineer.*

Man is an animal who uses tools. How far this is a matter of mental or how far of physical capacity, we need not discuss; the lower animals can do nothing beyond the limits of their own bodies. It is the capacity to supplement his own powers by the use of tools which has given man his advantage over the beasts. The perfection and completeness of the tools which he uses is the measure of the degree of his civilization. The distinctive feature of a tool is that it is made for an ulterior purpose; it is valueless in itself; it is useful only to increase the power and capacities of its inventors and its users. Engine is but another name for tool. The tools of the present day include the steamship, the railroad, the telegraph and a multitude of other things without which modern civilization could not exist. Creation, whether of substance or force, is beyond the power of man, he can simply direct the sources of power which already exist in nature. These sources of power are no greater or in any way different to-day from what they were when the first miserable man fashioned his first rude tool and used it to get the better of some wild animal. In those dark days these sources of power were unknown and undirected. In the lavish supply, which nature provides as bounteously for the feast which none attends as for the crowded banquet, they waited unused for a length of time which we have no means of measuring. They not only waited but much which would otherwise have been lost was preserved for the future, in the coal deposits and in the stores of oil and natural gas, the existence of which only the last half century has realized, and perhaps in other forms not yet understood. It is these sources of power which the engineer must direct; this direction is manufacture, it is not creation, but so far as mankind is concerned it has a similar effect.

The work of the engineer adds to the wealth of those for whom it is done without taking anything from anyone else; it is a generous work. There is this distinction between the work of the engineer and the commercial operations of the merchant. Every properly designed tool adds its share to the comforts of mankind; it either gives him what he did not have before or relieves him of labor required to produce what he already had. The shrewd business man simply secures for himself, or for the interest which he represents, that which would otherwise have belonged to another; he adds nothing to the wealth of his race, he distributes it in a different way; his business is based on selfishness.

Every manufacturing plant is a tool, it has no value except in its capacity to produce. It was the general characteristic of the merchant, from the earliest times, to keep his knowledge secret and to make the best bargain he could. Modern conditions render this impossible; there will soon be no secrets of trade by which profits can be made; knowledge of what is going on anywhere in the world is even now open to all and anyone who desires to do so can learn any specific thing. Profits must be made, not by buying cheap and selling dear, but by reducing the cost of production. The work of the manager is to handle his tools, it is to manufacture rather than to trade. While the products must be sold, the greatest skill must be shown in getting the largest results which the tools are capable of. The most successful manufacturer will not be the one who has the shrewdest salesmen to dispose of his goods, but the one who can manufacture his wares more cheaply and at the same time better than anyone else engaged in the same work. The most successful transportation line will not be the one whose agents are most active in securing business, but the one which is the most closely handled, which can carry its freight at a less cost to itself than any competing line. Permanent success will depend not on commercial drummers but on the intelligent engineer; not on the shrewd guesses of the so-called business man, but on the accurate knowledge of the manager who knows what his tools are, who knows what it costs to produce, who knows the defects of his plant and the features in which it may be improved, who in fact is applying all the intelligence of an educated man, not selfishly to getting the better of some other man who may know a little less, but generously to getting the best work possible for himself and his employers out of what he has to work with.

The passage of a race from one civilization to another involves the loss of some of the best features of the older life, leaving a void, while the new conditions, with their new virtues, are being developed. The new condition must reduce the number of people who work by themselves, it must reduce the number of men who seem to be entirely their own masters and who pursue their lives on independent lines; it must increase the number of salaried employees, the number of men who are working for fixed wages and who are apparently dependent on others. Its development will wipe out the small manufacturers, they cannot compete against the great concerns; it must wipe out many of the small traders and dealers whose business has always been that of middlemen. In fact, these changes make men members of communities, members of working organizations, members of what has been called an army of workers, but necessarily deprive them of many of the conditions which have hitherto done most to produce strong individual characters. Were this all it certainly would be an evil. The loss of independence is a great loss, it is always regarded with regret. Whatever his vices and wickedness, and they have been enormous, there is a noble element about the life of the savage, which will live in literature and song, long after his sins are forgotten. The strong features of American pioneer life, with its combination of manual labor and high intelligence, which bred the men who fought the Revolution, calls for the highest admiration and praise, in spite of the physical pain and suffering which wore out so many of these people before they had passed middle life. But no one would voluntarily go back to the conditions under which our grandparents were born, still less would he adopt the life of the noble savage.

I once knew a man, of singularly attractive personality, who, beginning as a civil engineer, nominally gave up that profession but really passed into one of the higher ranks of which it is capable and became a railroad superintendent and ultimately the president of a great railroad system. Throughout his career he retained the gentleness of his youth and the enthusiasm of his early manhood. In speaking of professional work and what I myself was doing, which was in the nature of general practice, he said that it lacked the satisfaction which belonged to watching and directing the development of a single great property. Like the emancipated slaves in the old Greek army, who being without a country, adopted valor and courage for their fatherland, so he, a childless man, adopted his work and loved it. He was not working for his salary, but in the satisfaction of seeing the great interests which were intrusted to him develop and expand. It was the true spirit which should actuate the engineer, the kindly noble spirit which can make a great corporation a blessing to the community which it serves.

You are citizens of a republic. This means that you have a responsible share in the government. You cannot hide this responsibility behind the loyalty of a subject. It is one of your first duties to understand the government which you not only live under but are responsible for. Had I the say about it, I would never give a degree to anyone who could not repeat the Constitution of the United States, and I would make this requirement as ab-

* Extracts from the address of George S. Morison to the graduating class of Purdue University.

solute for a scientific degree as for one in literature or even in law.

Little good is done by the man who only weeps and criticises. You will help to destroy the conditions which gave most interest to the history of the past and many of the traditions which people hold most dear. Savage and barbarous races must either be elevated to the life of their more civilized contemporaries or they must vanish. The entire world must be educated and one of the greatest dangers will come from this very source, when the number of half-educated people is greatest, when the world is full of people who do not know enough to recognize their limitations but know too much to follow loyally the direction of better qualified leaders. With the disappearance of ignorance will come the destruction of superstitions which have exercised such a momentous influence in the past, perhaps generally for evil but in many instances for good. There must be a great destruction both in the physical and in the intellectual world, of old buildings, old boundaries and old monuments, and furthermore of customs and ideas, systems of thought and methods of education. There must be destruction of old constitutions; destruction of races as they merge into one another; destruction of languages, in the gradual disappearance of all but a few of the most important, while even these in time may give place to one that is universal. It is not worth while to consider how this destruction will occur nor how much time it will require for its completion. The important fact is that destruction will come, not because the things which are destroyed are in themselves bad, but because however good and useful they may have been in the past, they are not adapted to the needs of the time.

It seems likely that material developments will come to a gradual pause, that the stimulus will be removed and that the densely populated earth may continue for centuries with comparatively little change; that an immense population will live comfortably and happily, and that the qualities which make the good citizen and the contented man will be more in demand than those which make pioneers and leaders in such periods as we are familiar with. There may be a time when everyone will understand the comfort and peace of mind which attend the adaptation of personal feeling to the general environment. However satisfactory this condition may be, whatever its delights and whatever the excellence and happiness which may be in store for the inhabitants of the thirtieth century, they are not for us. We have, however, one privilege which will not belong to them. In all history and in all periods of the world the honors are held to belong, not to whose who enjoy the results, but to those who have made these results possible. You, who are entering the world as the engineers of the twentieth century have the privilege of doing your full share in bringing forth the great changes which future generations may profit by. You have the privilege and the greater the privilege the greater are your responsibilities.

Another change is upon us, not one to be determined by the gage of war, but one which requires no less the unselfish patriotic spirit. From being a small and poor country we have become one of the greatest and the most wealthy nation in the world. From being a land of small producers where the means of every one were limited, we have become a nation in which great fortunes are common and where the advantages of wealth are often too highly valued. It is a good sign that many of our richest men are using their wealth less for the benefit of their descendants than for the general endowment of the community at large. This is good as far as it goes, but it is only a small part of what is really needed. We need the generosity of the true engineer; we need the integrity of the trustee; we need the self-sacrifice of the patriot. The only thing which can protect us against the dangers of our wealth is a spirit which appreciates the responsibilities which you assume as members of a family, as members of a community, as citizens of the State which has educated you, as citizens of the country which has made this education possible.

Letters From Practical Men.

Finish Directions on Drawings.

Editor American Machinist:

I have read with much interest the article by Mr. Moss, at page 433. There are several statements in this article which with your permission I should like to criticise.

Mr. Moss suggests that we omit all shade lines and show the finish by a heavy black line, which he believes to be an original method. We have in our drawing cases drawings made ten and fifteen years ago on which the finish is shown by a heavy red line drawn parallel to and just touching the finished surface.

This method of showing the finish has been obsolete with us for years. I cannot give the reason for its being discontinued, as it was obsolete long before I took charge of the drafting room. However, I can say that whenever it is necessary to refer to these old drawings they always give rise to more or less confusion.

It is *always* possible to make the "f" conspicuous, and it is *never* necessary to explain it to anyone wherever the drawing may be sent, as it will often be with the system of heavy black lines.

I can see one, and only one, redeeming feature of the heavy black line method, namely, it is sometimes necessary to finish a plane surface for only part of its length. Of course, this system shows this perfectly, while with the old system it is generally necessary to make a note on the drawing to that effect. However, this only occurs occasionally, and is insignificant compared with the disadvantages of the heavy black line system, such as giving up the shade lines; the confusion arising and necessary explanation when drawings are sent to strangers, as they are always liable to be; the necessity of drawing all unfinished surfaces with *very light* lines and consequent possibility of poor prints, followed by mistakes in the shop, for which the drafting room must shoulder the blame; the difficulty of making a change when it is decided to leave a surface unfinished which it was originally intended to finish; the extra time required before a drawing can be put into the pattern shop, as a big percentage of the work done nowadays is on rush orders when it is generally necessary to get a drawing into the pattern shop without waiting to ink it, this would not be easy with the method of heavy black lines.

We use a system of separate drawings for the machine shop, which seems to us to be ahead of any other system. It is much more convenient for the patternmaker to use a large scale, consequently in the greater part of our work they are made full size, in which case it is necessary to put on but few figures, leaving the patternmaker to scale all unimportant parts. All notes and figures which will be needed only by the machinist are omitted. This leaves the drawing with less to confuse it, and the finish marks show plainly; the draftsman does not have to bother with putting on a lot of unimportant dimensions and the consequent chance of error; a rush order can be started in the pattern shop much sooner than if the drawing was held back to be finished and inked suitable for the machine shop.

The machine-shop drawings can be made while the pattern work is going on. These can be either tracings or pencil sketches, depending on the job, and can be made of a size which is most suitable for the machinist to handle. They need not be to scale in any way and can often be made by tracing a shop sketch, already at hand, of a similar piece, but different in size, as they need only bear a resemblance to the casting. Only such dimensions as are needed by the machinist are put on, leaving no possible chance of an error by reading the wrong figure or by finishing parts which were meant to be rough.

Of course all of this requires a little more time in the drafting room, but what are a few hours' extra time spent in the drafting room compared with weeks, or even months, which may be spent on the same job in the shop?

Mr. Moss speaks of the "omission of the allowance for finish by patternmakers." This is often done, but there is little need

of the casting being made that way, as a pattern should never go to the foundry until it has been measured by the draftsman. Of course, this takes still more of the draftsman's time, but it is more than compensated for in the long run by time saved in the shop. The time taken to look the matter up and make the necessary changes when a mistake gets into the shop is generally greater than that spent in measuring the pattern, to say nothing of the expense which often occurs by throwing away partly finished work, riveting on a piece here or chipping off there. It is very seldom that a pattern goes by me without first being sent back to the patternmaker for corrections. It is always cheaper to do it once for all in wood than many times in iron, as might be the case if it was only a little chipping that was required.

A drawing-room management which "fails to seek for means of improving its efficiency" had better be "fired," and the sooner the better. At page 444 in the same issue Mr. Tecumseh Swift speaks of places where the draftsmen are not allowed to go into the shop. I have worked in just such places. All a draftsmen could learn of the shop and its workings must be done either before work or during the noon hour.

There is nothing that will increase the efficiency of the draftsman as much as knowing the exact capabilities of the shop. This can only be learned by actual observation. If you are making an addition to or alterations in a machine, go into the shop and look at a similar machine. You will often see something which you hadn't thought of before. Call up the foreman and tell him what you are going to do and how you propose to do it, allowing him to make as many suggestions as he wants to, and you may depend on it they will be at least worth considering. A reasonable amount of time spent in this way is well spent.

FRED S. ENGLISH.

An Alleged Breach of Confidence.

Editor American Machinist:

I would like to ask the opinions of your readers on the following question of breach of confidence:

In the drawing room where I am employed is an engineer, a graduate of one of our leading technical schools, a member of the American Society of Mechanical Engineers, and who in his eighteen years of experience has held several very responsible positions. He is now in a position he regards as beneath his ability and has been casting about for an opportunity to better himself. Not long since he wrote to one of the constituent companies of the United States Steel Corporation inquiring if they had a vacancy. A few days later he was called up by our chief draftsman and handed the letter of inquiry he had written, togther with a demand to know what he meant by writing to outside concerns. He again wrote to the company asking for an answer to his first application, also asking an explanation of how his first letter came into the hands of his present employer, as he regarded such a proceeding as a breach of confidence. In reply he was told that although the two concerns had no agreement regarding the matter of hiring each other's men they regarded it as merely a business courtesy to a firm doing business in the same city as themselves to forward to them any applications received from the firm's employees.

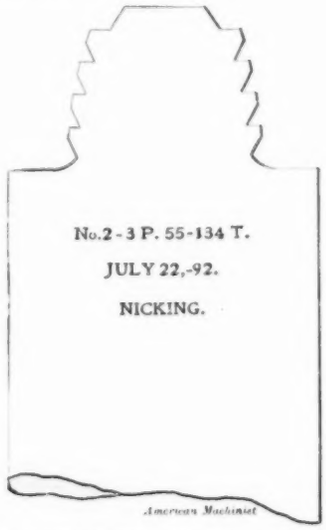
I can easily understand the reason of firms engaged in a similar line of business agreeing not to hire each other's men, less easily understand the reason of concerns engaged in dissimilar lines of business making such an agreement, while I cannot understand at all why a breach of confidence is necessitated by having such an agreement. The two concerns I speak of were not engaged in similar work, they claim they had no agreement regarding each other's men, yet out of courtesy would forward an applicant's letter to his present employer.

After hearing of the above case, the first of the kind that ever came to my notice, I began to make inquiries of my friends in other drawing rooms in this city—Pittsburgh—and was told the practice had become quite common in the last few months. Does business courtesy, or even business prudence, require such breaches of confidence? PERSEVERANCE.

The Stepped Stocking Cutter.

Editor American Machinist:

At page 423 we note a description of a stepped stocking cutter, under the title "Some New Things."



AN OLDER STEPPED STOCKING CUTTER.

In view of the fact that this style of cutter has been made for some time, we think possibly you may have "mislocated" the item, for we are sending you a sketch that is a copy of one of our forming tools, showing that this is an old method of making a stocking cutter that has been used. BROWN & SHARPE MFG. CO.

A Glass Covered Desk.

Editor American Machinist:

I venture to submit the following device, which I know from experience will save many minutes each day for such engineers and draftsmen as can apply it. This time-saver consists of a piece of plate glass large enough to cover one's desk or table top, and a piece of drawing paper the same size to which various pages of formulas, tables and other oft-referred-to data are pasted. The paper, with the attached data, is spread out like a large desk pad on the desk, and the glass laid on top of it. Some of the advantages of this device are that it affords an excellent surface on which to write; the data most needed are always in plain sight or easily referred to; the data are preserved, being none the worse for their constant use; new matter may be easily inserted.

S. H. M.

The Annual Convention of the National Metal Trades Association.

The proceedings of the above-named convention which was held in Cincinnati, April 8 and 9, were not of a nature to have any large measure of interest to our readers or to justify an extended report, as the convention was devoted almost entirely to the administrative and business affairs of the association. The report of the commissioner and secretary showed a growth in membership during the past year of about 40 per cent. and the report of the treasurer was equally satisfactory. The finances of the association are, in fact, in such excellent shape that a substantial reduction in dues will no doubt be made at an early date by the new Administrative Council.

Reports were read from the various districts regarding the "labor situation" and outlook. The general prosperity of the country was reflected in all these reports and no signs of impending trouble were noted, except in Chicago and Worcester. The advisability of making agreements with labor organizations was discussed at considerable length, but without a vote being taken upon it. There is no doubt that the experience of the association with the New York agreement has very materially weakened the disposition to make agreements of this kind.

The constitution of the association has been looked upon for some time as inadequate to its scope and purposes, and for some months a special committee has been at work on a new constitution which should effect a reorganization of the association on the lines which experience has shown to be advisable. A draft of a proposed constitution in the form of a report of this committee was submitted which

was discussed at great length and very divergent views soon developed. At the start the gap between the parties was a wide one, but it did not take long for each to find out that the other had good arguments. It was eventually decided to enlarge the constitution committee so as to insure the proper representation of all parties upon it, and some resolutions were passed instructing this committee on the general lines on which it was to revise its draft constitution, which is then to be voted upon by the membership through a letter ballot. These instructions reconcile the divergent views in an admirable manner.

The writer has never seen a more admirable case of men of divergent views "getting together" than this. While the argument was a warm one, it was in the best of temper throughout and the conclusion demonstrated, as nothing else could, the substantial unanimity of the association, which is stronger for the conclusion arrived at and stronger for the discussion which preceded it.

The officers elected for the forthcoming year are: President, S. W. Watkins, of Milwaukee, Wis.; first vice-president, E. F. Du Brul, of Cincinnati, Ohio; second vice-president, A. H. Bullard, of Bridgeport, Conn.; treasurer, N. B. Payne, of Elmira, N. Y.; commissioner and secretary, V. H. Olmsted, of New York city.

Additional to the proceedings of the convention proper, a notable feature of the gathering was the interest shown in the premium plan. Mr. Halsey had been asked to deliver an address on the plan, which he did at the dinner of Tuesday evening. He was followed by Mr. Watkins, of the Christensen Engineering Company, of Milwaukee, who gave his experience with the system and spoke more favorably of it than probably has ever before been done by anyone.

Considerable progress has been made in the adoption of the plan by the manufacturers of Cincinnati. It is now in use by the American Tool Works Company, the Bickford Drill and Tool Company, the Bullock Electric Manufacturing Company, the Cincinnati Milling Machine Company, the Cincinnati Planer Company, the Cincinnati Shaper Company, the Lodge & Shipley Machine Tool Company, the Miller, Du Brul and Peters Manufacturing Company, Rahn, Meyer & Carpenter, Schumacher & Boye, Steptoe & Co. and the Triumph Electric Company. Others have already taken steps to install it, and still others are giving it serious consideration.

The hospitality for which Cincinnati is famous was responsible for much of the success of the convention. The Cincinnati Metal Trades Association were the hosts of the occasion, the entertainment provided being a banquet at the St. Nicholas Hotel, in which nothing was lacking to the enjoyment of the guests, and a less formal smoker and vaudeville at the Grand Hotel. Mayor Fleischmann was present at the banquet and welcomed the visitors to the city. He made the surprising statement that the manufactured output of Cincinnati per capita was larger than for any other city in the country. The toastmaster was Mr. Fosdick, of Fosdick & Holloway, and no account of the proceedings could be complete that did not mention the scintillating wit with which he presided. He is understood to be one of the institutions of Cincinnati and the official toastmaster of the city.

The Entertainment Committee which had matters in its immediate charge and which received the thanks of all over and over again, both formally and informally, was composed of the following gentlemen: J. C. Hobart, H. M. Norris, R. K. LeBlond, Robt. McGowan, Wm. Lodge, F. A. Geier, C. H. M. Atkins, S. P. Egan and J. H. Day.

The day following the convention was devoted to visits to the various shops, and many remained over to avail themselves of the opportunity.

The New York Trade Schools.

The graduating exercises of the twenty-first class of the New York Trade Schools occurred on April 9 and were of a most interesting character. It may not be known to all of our readers that these schools are at once the largest and the oldest of their class. The number of graduates was so large that most of the evening was taken up in the distribution of the certificates and a large number of prizes and honors. The school since it began has graduated 6,500 students, the number turned out on this occasion being 163. The students of this school are not all, and probably not more than one half from New York city and vicinity, the others coming from all parts of the United States. In this case, thirty-five States of the Union, including Oregon and Florida, Louisiana and Michigan, and also Canada, were represented, one of the students being a bright-looking negro from North Carolina. The trades taught in the schools are not in the machinery line, but have to do almost entirely with those which are still almost entirely handicrafts. The trades taught include bricklaying, plastering, plumbing, pipe fitting, electrical work, patternmaking, house painting, fresco painting, blacksmith work—mostly of a decorative character—and printing. The school buildings cover a large area and each department is well equipped for its work. The schools are not free, but the fees, which cover tools and materials, are much lower than the actual cost, the school being amply endowed.

The system of instruction followed at the school is what is known as the "Auchmuty System," and was originated by the founder. Under this system, a course of instruction is arranged by which both the practical and theoretical branches of a trade are taught, so that not only is manual skill quickly acquired, but the scientific principles that underlie the practical work are also taught. This system differs from anything attempted in trade instruction previous to its inauguration at the New York Trade School. It has produced remarkable results and has attracted much attention in this country and Europe. In the training of young men for the handicrafts, the combination of the trade school and the workshop is best suited to modern conditions. The trade school to give the young man a knowledge of how to use his tools, how to do work, and the theory of the trade, the workshop to give the young man experience, facility and speed of execution. For each trade taught at the school, a course of instruction is prepared, which outlines in detail what work the student is required to go through, and the order in which the work should be performed. At first, the student is put on work that is simple, but as skill and a workmanlike use of the tools is acquired, he is advanced to work that is more difficult and complicated, until he is made familiar with the various branches of his trade. The work given the student is thoroughly practical, such as will be met with in actual practice at the trade. One important work of the school, and which all may not think of is its missionary work in sanitary plumbing through the distribution of its graduates all over the Union.

Proposed Increase of Import Duties in Switzerland

Though the affair seems not to be attracting so much attention as in the case of Germany's new tariff, it is a fact, as set forth by advance sheets of consular reports under date of April 7, that Switzerland is proposing to impose additional duties upon articles imported into that country, or rather that the Federal Council proposes to fix a schedule of duties which are to be used in negotiating new commercial treaties; the present commercial treaties with other foreign countries expiring in 1903. It is in fact distinctly stated that it is not expected that the duties will be collected but that it is intended to use the power to assess these duties in a "protective and political way." This proposition is not made without meeting keen opposition among the people of Switzerland, however, and according to the report "is rebutted with decided emphasis by the greater number of the newspaper and other writers, who are now eagerly discussing the subject. It is declared that, in the not improbable event of the actual application of the proposed tariff to imports, the cost of living will be increased to a point almost insupportable by the working classes; that agriculture will not derive from it the expected advantage, since it cannot possibly supply the demand that is now met by imported products; and, finally, that Swiss industry, already

hard pushed by competition, will be obliged to pay higher wages on account of the increased duties, and will thus be placed in an even less favorable position than at present with respect to its great commercial rivals. This last objection is of an importance that can hardly be exaggerated, since Switzerland is relatively the greatest exporting country in the world, not even England being excepted, and its exports are almost exclusively manufactured articles.

"The reality of the peril to the workingman, and indirectly to the manufacturer and exporter, which would arise from the increased cost of living is clearly shown by two considerations pointed out by a writer in the *Allgemeine Schweizer Zeitung*. It is estimated that a laborer who earns 4 francs (77 cents) a day in Switzerland can live as well as his German colleague who earns 5 francs (96 cents), because the duties on the necessaries of life are so much lower in the former country. Another calculation shows that under the proposed tariff the yearly expenses of living for a workingman's family consisting of five persons would be increased by nearly $40."

Like the German movement for higher duties the one proposed by Switzerland is said to have been originated or to be largely in the interest of landed proprietors, though in Switzerland the land owners are mostly small holders and not great landed proprietors as in Germany. There is no direct statement as to the change in the proposed duties on machine tools. On agricultural machinery the proposed increase is from 80 cents to $2.00.

A German Patent Decision.

Deputy Consul General Simon W. Hanauer has sent us the following information from Frankfort-on-Main, Germany:

The German patent law ordains that three years after the grant of a patent it can be declared void if the owner of the patent neglects to work the invention by practically making and distributing the patented article, or at least to take the necessary steps for doing so.

On the strength of this provision of the law, application was made to the Patent Office to declare void a patent for an American type-setting machine, as also six additional patents granted to the same owner for separate articles having a technical connection with the machines. The Patent Office denied the application, and the case being appealed to the Imperial Supreme Court (tribunal of last resort in Germany) the latter sustained the decision of the Patent Office as far as the patent for the type-setting machine (the main question) was concerned, on the ground that the owner of the patent had made reasonable—though unsuccessful—efforts to find customers for his machines. As to the other six patents, the application to void them was granted, the defendant having admitted that the manufacture of the articles covered by them in Germany would not prove profitable and therefore he did not intend to work these patents practically.

Hardening Plaster of Paris.

One of the most objectionable features of plaster of paris is its softness. It is already extensively used in all the trades, and if it could be cheaply and easily hardened it would undoubtedly be used much more. Abraham Brodsky, a Russian living in Canada, has recently patented in the United States a process by which it is claimed that any article of plaster of paris may be made as hard as stone, the kind of stone not being specified. The following is a description of the process employed:

"I take a suitable quantity of alum which when reduced to a liquid condition, by melting and boiling the alum, forms a bath of boiling alum of sufficient quantity to cover the plaster of paris which is to be subjected to the indurating effect of the alum. This boiling alum bath is composed essentially and solely of alum, as distinguished from a solution of water and alum in which the water is largely in excess of the alum, and good results have been obtained by me by immersing the plaster of paris in such a pure bath of boiling alum. It is found, however, that the boiling of alum drives off the water of evaporation. Hence the alum is reduced to the consistency of a thick syrup when it is kept at a boiling temperature for any considerable length of time, and to overcome this I find it desirable to add a liquid which will compensate for the loss of the water of evaporation and maintain the alum bath in a state of liquefaction proper to impregnate the plaster of paris. The acid which I have used is acetic acid in the form of vinegar, the same being diluted by the addition of a small quantity of water; but the quantity of the water added to the vinegar depends upon the strength of the latter.

"It is my practice to place the desired quantity of lump alum (of commerce) in a suitable vessel, preferably an acid-proof vessel of an earthenware nature, and at the same time to pour into the vessel a small quantity of the acid. The vessel is now heated to a temperature sufficient to melt the alum, thereby producing a bath of melted alum which is kept at the boiling point (a seething state) during the treatment of the article. When the alum has been reduced to a boiling liquid and a thin skin appears on the surface thereof, immerse the plaster-of-paris article in the bath and keep it well covered with the liquid alum. It is necessary to subject the article to the action of the boiling-alum bath for a period of an hour, more or less, depending upon the thickness of the article to be indurated. During the boiling operation the alum is liable by evaporation of the liquid to turn to the consistency of a syrup; but it is necessary to prevent this in order that the alum may be kept in such a state of liquefaction as will insure its ready percolation into the plaster-of-paris article. This is accomplished by adding from time to time a small quantity of the diluted acid into the bath, preferably at a point a little to one side of the article. To prevent the freshly-added liquid from arresting the boiling of the alum, heat the liquid previous to pouring it into the boiling bath of alum.

"One and a half pounds of commercial alum to four fluid ounces of diluted vinegar is the proper proportion for small articles. Previous to placing the article in the bath, I find it desirable to heat it, say by placing it on or near a stove."

Orientalism and Mr. Schwab.

With so much talk in circulation about our Chas. M. Schwab, president of the United States Steel Corporation, a few words relating to the new specially designed palace car for his private use may be of interest. The car is now nearing completion at the works of the Pullman Palace Car Company at Pullman, Ill. For magnificence and cost, it far outstrips anything made heretofore by this company. The friends of Chief Designer Snyder have secured some of the details of its construction. The length over all is 70 feet. The 20 feet laid out at one end for the observation vestibule is so nearly all window area that the traveler can easily imagine himself riding in the open. The interior decoration scheme is remarkable for its beauty and grandeur; every piece of furniture is of special design and hand carved; mahogany is the principal wood used for finish, with many elaborate designs of inlaid work in maple, holly and curly birch. Tiffany art glass is used in profusion. The ceiling and panel decorations are all painted by a Boston artist. Each compartment is finished in a different color tone, the dining room in green, Mr. Schwab's room in red and Mrs. Schwab's in blue shades. The private car recently completed for William C. Whitney cost barely half as much as the traveling home of the steel magnate.

Mr. Schwab seems to be entirely competent to use and enjoy all the benefits derived from his salary. Only two or three years ago he occupied a very unpretentious brick house in the town of Braddock not far from the Carnegie steel plant, with workingmen for his next door neighbors. Mr. Schwab's success is attributed preeminently to his magnetic personality and will power. "PITTSBURGH."

A Slav employed at the Homestead Steel Works recently stood on a pile of rails and reached up to light a torch by an arc light and was instantly killed. He was employed in another part of the works and it took three hours to identify him.

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The Consulting Engineer in England.

A striking example of the different results produced by two different methods of procedure may be seen when we compare the developments of shipbuilding and marine engine work in Great Britain with that of bridge building and of locomotive construction. The fact has been much commented upon that one of the great drawbacks to the higher and better development of the art of bridge construction in Great Britain is the fact that such work is in the hands of consulting engineers in London. When a bridge is to be built one of these engineers, who is in no way directly connected with a bridge constructing establishment, is consulted. He designs the bridge. The cost of the bridge is usually not very important to him. The most important thing to him is that the bridge shall not fall down. Consequently, in order to make it safe, he simply loads the iron into it, letting the cost run to about what it will. To simply adopt or adapt a bridge that has already been built previously, perhaps in the same works where the new bridge is to be built, would be an unheard-of thing. He does not propose to adopt a bridge designed by Jones, but must design one himself, and it must be different from any bridge that has preceded it. Much the same methods, though perhaps not to the same degree, apply to locomotive construction.

Strange to say, an entirely different course has been pursued with regard to marine work. Steamships and their engines have not been designed by consulting engineers. The practice is, and has been from the first, for a man wanting a steamer to simply go to a shipbuilding concern, tell them what size vessel he wants and what conditions he wants it to fulfill, and to depend entirely then upon the firm building such vessels and their reputation for results. They build these vessels entirely without dictation from the consulting engineer. The nearest approach to it has been that, occasionally, an inspector has been appointed representing the owner who has been present in the works during construction, but his authority or influence upon the construction has been exceedingly limited, and in fact as soon as one of them has attempted to go outside the narrowest limits in the inspection of workmanship he has been informed that it made no difference what he thought or what he wanted the concern had contracted to build a certain ship to certain standard specifications and to perform a certain office in a certain way; such a ship would be built and it would be satisfactory and guaranteed to be so, but that if he was to have his way regarding matters of construction no guarantee would be given, and in fact the vessel would not be built. There are those who attribute the supremacy of Great Britain in shipbuilding to the fortunate incident or circumstance that the shipbuilding industry was commenced in this way and that the consulting engineer, as he is found in bridge work and in locomotive work, has been unknown in marine work.

One result of this is that shipbuilding firms have specialized. With here and there an exception, each yard on the Clyde or the Tyne has confined itself to a few sizes and types of vessels. Especially has this been so with what are known as tramp steamers, which carry the bulk of the ocean freights and which have been in this way developed into highly efficient transporting machines, especially when their cost is considered. This cost is in the way of being appreciably reduced by the admixture of American shop and construction methods which is now taking place.

The Steam Turbine.

The fact that the Metropolitan District Underground Railway of London has ordered ten steam turbines, each of 7,000 horse-power, instead of reciprocating engines, is being commented upon, and there are those who express the opinion that the days of the reciprocating engine are numbered. Whether this is true or not there can be little doubt that the turbine steam engine is making rapid headway. The De Laval steam turbine, which was exhibited in this country for the first time at Chicago, but which until lately has been practically unknown here, is now being made by an American company, which we are informed has orders for all it can produce for some months to come. These are being sold at a price considerably higher than an ordinary high-speed engine of same nominal power, which of course means that the purchasers consider them to be for their purposes better. They are being compounded and used under varying pressures and conditions with apparently entire success where the engineering connected with the installation is properly considered and looked after. For electric lighting plants they seem especially well adapted, as there is of course practically no limit to the speed at which they can run, their speed being at least equal to that of any armature that can possibly be constructed. This we understand results in great economy, owing to the lower cost of a dynamo to generate a given current and the economy of space is often important, to say nothing of the lessened repair bills which is said to amount to an important item. There is moreover no jar or vibration from reciprocating parts, and altogether it seems likely that the steam turbine is destined to exert an important influence in steam engineering circles.

"Free Trade Activity."

Those manufacturers of machinery who have had the temerity to express their convictions as to matters affecting their own business affairs, as fifty-eight of them recently did in our columns, are severely

rebuked by the editor of the *Bulletin of the Iron and Steel Association*, who, under the head of "Free Trade Activity" relieves himself as follows:

"Here is another sign of free trade activity in the columns of the AMERICAN MACHINIST, of New York, for March 13. Fifty-eight manufacturers of machine tools, etc., respond to an inquiry for their views on the reciprocity question. A majority express their approval of reciprocity because, of course, foreign competition no longer menaces their home market, while a larger control by themselves of foreign markets would, so they think, add to their profits. They do not reflect that the 'reciprocity,' or free trade, that they suggest for other industries than their own would surely and seriously affect the prosperity of the whole country, so that, in the long run, they would not sell as much machinery as they are now doing without reciprocity.

"The AMERICAN MACHINIST apparently does not know any more about this subject than its correspondents, for it says that 'the majority of these manufacturers have been and still are protectionists.' It might with equal truth say that Calvinists are Universalists, or that Mr. Bryan is an ardent advocate of the gold standard. That is an old trick of free traders—posing as protectionists."

By this we learn that if a man criticises a thirty-story office building and says he don't need such a tall building in his business he is the enemy of all office buildings of whatever hight they may be and is an ignorant fool.

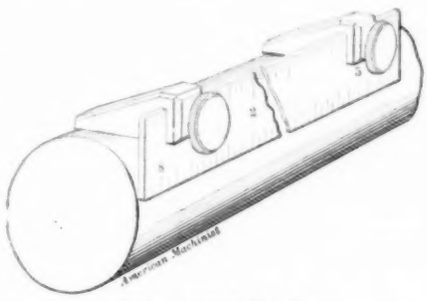
Testimony for and Against the Metric System.

Those of our readers who are interested in the question of the introduction of the metric system, as nearly all of them are, should procure and read a copy of the testimony given before the Committee on Coinage, Weights and Measures, which has charge of the bills now before the House of Representatives. This testimony is by no means one-sided, but on the contrary sets forth pretty nearly every argument that can be conceived of on either side. The witnesses represented a wide variety of occupations and lines of manufacture; many of them had given very considerable study to the subject and they were nearly or quite all subjected to examination by different members of the committee, some of them favorable to the one side and some to the other, so that the basis of the statements made by each witness is nearly always clearly brought to view and the real value of the argument shown. Quite a number of men testified who are well known to our readers, and several manufacturing concerns whose names are familiar in our pages were represented. The testimony is contained in a report of 240 pages, is well indexed and is well worth examination by all who are interested in the subject. We presume any reader can obtain a copy by addressing a request to his representative in Congress.

Some New Things.

KEYSEATING RULE BLOCKS.

The blocks illustrated herewith are clamped to an ordinary steel scale and

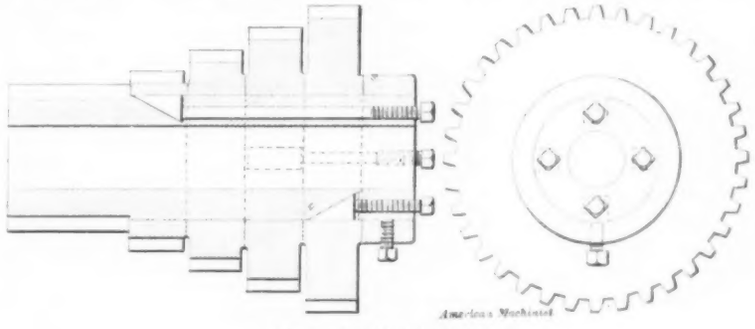


KEYSEAT RULE BLOCKS.

convert it into a keyseat rule. They are made by the Sawyer Tool Manufacturing Company, of Fitchburg, Mass.

A SPEED-CHANGING DEVICE.

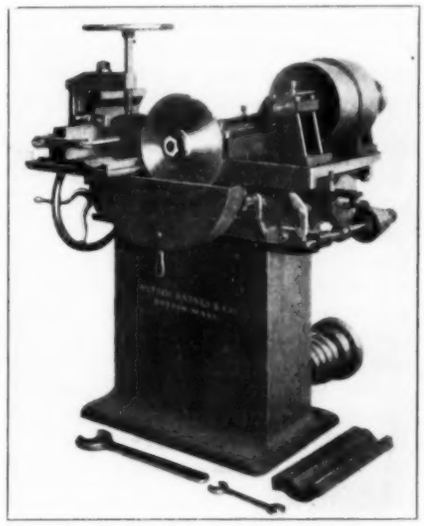
The cut, adapted from a recent patent, shows a speed-changing device available for some special uses. A shaft has upon it a long sleeve with a wide-faced pinion at the left-hand end of it by which it is driven. Upon the same sleeve are four, or any other number of gears of different diameters supposed to mesh into other gears upon another shaft to be driven. These gears are loose upon the sleeve, but either one may be made tight by screwing in a long screw the end of which pushes forward a wedge which does the tightening. There are separate wedges and screws for each gear, placed in different positions around the sleeve so that they will not interfere with each other. The wedges and screws, as shown, can only be operated when everything is stopped, but it obviously would be possible to devise means for moving the different wedges while the sleeve was turning. The shaft and sleeve could of course be driven at different speeds by the different gears instead of driving through them.



A SPEED-CHANGING DEVICE.

METAL SAW CUTTING-OFF MACHINE.

The accompanying half-tone illustrates an improved cutting-off machine made by Nutter Barnes & Co., of Boston, Mass. Bar stock of any shape and any size, up to 9 inches in diameter, can be handled in this machine. The stock is brought up against a stop and securely clamped in a shoe which is surrounded by an oil channel for catching the lubricant and returning it to the tank under the saw. The saw is 13 inches in diameter and ⅛ inch thick. It is mounted on an arbor which is geared to the driving shaft, and this shaft is driven by a two-step cone pulley. The driving shaft and saw arbor are carried on a traveling slide which is fed forward automatically and has a quick return. The feed mechanism at the end of the machine gives a number of feeds ranging from ¼ inch to 1 inch per minute. The saw makes one cut through stock up to 4½ inches in diameter; 4½ to 7 inch bars are cut to the center. The stock is then turned half way round to a gage



CUTTING-OFF MACHINE.

and a second cut taken. Bars from 7 to 9 inches in diameter require three cuts, the stock being moved twice in the shoe. A smaller size of this machine is made, taking in work up to 4 inches in diameter.

It is announced that the trouble between the Southern Railway and the machinists at Birmingham, Ala., which began nearly a year ago, has been settled to the satisfaction of both sides. Forty-nine men orig-

inally quit work and many of those have since gone to work elsewhere. Some of the men who took their places will be retained.

St. Louis Fair Machinery Building Contract Let.

The contract for the Machinery Building has been awarded by the Louisiana Purchase Exposition Company, at a public letting, to Smith & Eastman, a general contracting concern, for $496,957. The Machinery Building is one of the largest of the exhibit group, its dimensions being 525 by 1,000 feet.

It is announced that the recommendation of Admiral Melville to establish an engineering experimental department at Annapolis has met with approval and that the Naval Committee of Congress has agreed to include in the annual naval bill an appropriation of $400,000 for it. This new department will undoubtedly be of very great usefulness to the navy, and it can be expected also to be beneficial to commercial marine interests.

The Standard Chain Company, with headquarters in Pittsburgh, has just completed at its works in Lebanon, Pa., the largest chain ever made, so far as is known to this date. The chain measures 330 fathoms and has passed a test of a 600,000-pound strain. Interested manufacturers abroad had insisted that such a chain could not be made by the Pittsburgh company, and a representative of the British Lloyds Register Association, of London, was present at the final tests made.

Frank H. Mason, Consul-General of the United States at Berlin, has sent a report to the State Department, in which he gives a very interesting and instructive account of Berlin's new electric underground railroad. In the building of this road the interests of the people of Berlin seem to have been thoroughly kept in view. The character of the structure (part of which is above ground) and of the stations, its location and the terms upon which the franchise was granted are all admirable and represent advanced ideas of civic business affairs.

Storms, earthquakes and what not apparently never interfere with the publication of papers; no matter what happens, the sheet comes out. But shipwreck is capable of upsetting the otherwise imperturbable regularity of the press. The AMERICAN MACHINIST, one of the best engineering papers going, is partly printed, I believe, in this country, and has a British section, but it is otherwise essentially an American paper, and last week's issue was on board the "Etruria" on its way across. The liner was disabled (the Atlantic liner, of course, not the penny-a-liner), and consequently there could be no issue. Whom will the ubiquitous, complaining subscriber write to this time? The Weather Clerk, presumably.—*Imperial Newsagent*, London.

More than 300 employees of the New York Navy Yard have signed a petition against the proposed extension of their annual vacation from fifteen days to thirty days, with pay, urging that the extension would increase the cost of the work of construction to such an extent as to endanger the tenure of their jobs. This shows considerable thoughtfulness on the part of the petitioners. It is well known to our readers that we favor vacations for all workers, and we are not able to see why clerks require or deserve a longer vacation than those who work in the shops, but from the shop standpoint two weeks is at the present time probably long enough. If the employees of private establishments could generally have a vacation of two weeks, or even of one week, with full pay, they might think themselves fortunate. The total stoppage of wages when a fellow takes a few days rather takes the cream off, but by taking long views and planning the year as a whole it is still worth while to take the time when it is possible.

Personal.

Charles Hansel, formerly vice-president and general manager of the National Switch & Signal Company, has been elected assistant to the president of the Pneumatic Signal Company, with offices in New York and London.

Among those who have lately sailed for Europe are John Fritz, of Bethlehem, Pa.; E. W. Bliss, president of the E. W. Bliss Company, Brooklyn; Walter L. Clark, of the Niles-Bement-Pond Company, and J. W. Duntley, president of the Chicago Pneumatic Tool Company.

Thomas R. Morgan, formerly of Alliance, Ohio, has been made secretary and works manager of the Wellman-Seaver-Morgan Engineering Company, of Cleveland, Ohio; the title of the firm having been changed in recognition of Mr. Morgan's connection with and services to it.

Obituary.

B. Frank Wood died at Bennington, Vt., April 5, seventy-five years old. He had a wide reputation as a builder of powder machinery, had been connected with the Bennington Machine Works forty-two years and had erected thirty-five powder mills in America, Russia, Canada, Cuba and Mexico.

William R. Havens died at Denver, Colo. March 20, sixty-six years old. Mr. Havens, who was a machinist, went to Colorado in 1860 and later started a shop at Black Hawk, in that State. About twenty years ago he with others founded the Colorado Iron Works Company at Denver, of which he was superintendent until four years ago.

William Imhauser, inventor and manufacturer of watchman's time detectors, died at Ronkonkoma, L. I., April 4, seventy-seven years old. Mr. Imhauser was a native of Germany and came to the United States in 1867 and very soon went into business for himself and was active until five years ago. He received many awards from expositions for his detectors.

Commercial Review.

NEW YORK, Monday, April 14.

MACHINERY TRADE NOTES.

The points already made by the steam turbine as a commercial rival of the steam engine have just been substantially reinforced by the closing of two contracts for large Westinghouse turbines for railways in the Middle West. One of these contracts calls for two 1,000-kilowatt turbines for the Cleveland, Elyria & Western Railway, the other for three 1,000-kilowatt turbines for the Pittsburgh, McKeesport & Connellsville Railway. The four 5,000-kilowatt Westinghouse turbines for the Metropolitan District Railroad of London (two of them at least to be built in America) have already been reported, as have the two 1,000's for the De Beers Consolidated Mines, of Kimberly. Another order which the Westinghouse interests have on their books and which has perhaps not yet been mentioned calls for a 400-kilowatt turbine for the Johnston Harvester Company, Batavia, N. Y. In the judgment of a man speaking with some authority, the steam turbine has before it a future of great importance, perhaps of chief importance in certain lines of electric work. Such lines are those in which close governing, a high degree of economy and continuity of service are especially required, which in plain language means that its field will be found particularly in railway and lighting work. These are not necessarily the only purposes, however, for which it may prove useful, and serious experiments are now being made with a view to its further adaptability. The turbine is not expected to supplant the steam engine entirely, but rather to occupy a position of prominence along with other steam-power machinery, such as is held, for instance, by the Corliss type of engine.

This view is conservative as compared with some. An example of the more radical is the prediction of a Philadelphia engineer that five years will see the end of the Corliss type of engine in favor of the steam turbine. The latter seems, however, to be competing with the high-speed almost as much as with the Corliss. Many consulting engineers are taking the turbine matter up. A Western electric railway company which had in view to install 50,000 horse-power in engines, has decided to postpone the project for a year and take bids on turbines.

One of the most interesting achievements of the turbine is the success of the De Laval Steam Turbine Company. Since the first of the year the company has booked orders for at least seventy-six machines, most of them direct connected to dynamos, a few to pumps. Among the larger machines were the following: For the Ramapo Foundry Company, Mahwah, N. J., 225 horse-power; Ludwig & Co., New York city, 112 horse-power; American Cigar Company, 110 horse-power; Eaton, Cole & Burnham, Bridgeport, Conn., 112 horse-power; Oil Well Supply Company, Pittsburgh, two of 75 horse-power; Berkshire Box & Paper Company, Philmont, N. Y., 110 horse-power; D'Olier Engineering Company, Philadelphia, 110 horse-power; Mansfield, Crestline & Galion Railway, Cleveland, Ohio, 225 horse-power; National Ring Traveler Company, Providence, R. I., 150 horse-power; Pennsylvania Sugar Refinery, Philadelphia, three of 300 horse-power, two of 100 horse-power and about eighteen smaller ones; Delaware, Lackawanna & Western Railroad, 55 horse-power; Solvay Process Company, Syracuse, N. Y., two of 50 horse-power and two of 35 horse-power; Prescott (Ariz.) Electric Company, 300 horse-power. There are four De Laval steam turbine factories in Europe and about 4,000 of the machines have been installed since 1893. The price of a steam turbine is about $10 a horse-power at 100 horse-power sizes, which is figured to be 50 per cent. above the average price of a high-speed engine of that size.

We have trustworthy information that the General Electric Company is building, or interested in, a steam turbine—the Curtis. Two of these, of about 1,500 horse-power each, are going in for street-railway purposes at Grand Rapids, Mich., and it is quite probable that the Chicago Edison Company will place an order for several of them of 10,000 horse-power each if the contract has not already been let at this writing.

Deliveries on large tools are pronounced by an eminent authority on that branch of the market to be getting worse and worse. A man who has occasion frequently to buy tools states that even light machinery takes sometimes eight or ten weeks to obtain, and milling machines three or four months.

The slightly improved business situation manifest in Germany for some time appears to have gotten around to the machinery industry, for a marked improvement in demand for American machine tools is manifest in the trade of one of the most prominent import houses.

The E. W. Bliss Company, Brooklyn, N. Y., has purchased the press and coining machinery business of the Orr & Hess Machine Company, Philadelphia, whose presses have been used in the United States Mints. Heretofore the Bliss Company has not made a specialty of coining presses, but by acquiring this business, and with its present large facilities for building all types of presses for all kinds of sheet-metal work, it is in a position to supply improved machinery especially for the manufacture of coins, medals, regalia and similar kinds of embossing work.

The Grant Tool Company, Franklin, Pa., has orders on hand for ten vertical boring mills, four of them 8-foot and six of them 10-foot ones. The company is rushed with work and is becoming still more so.

Edward W. Irwin, New York agent for the Grant Tool Works, will move May 1 from 120 Liberty street to the new building at No. 116.

Within the last few days, Wells Bros. Company, Greenfield, Mass., manufacturer of taps, dies, etc., has broken ground for an addition to its factory, intending to build a fireproof addition of about 125x40 feet, to be used for office and stock room. With this addition the company's present factory will have in the neighborhood of 40,000 square feet of surface. The enlargement will give additional room for machinery which is being put in and which will add very materially to the facilities for manufacturing. The outlook for the coming months is very good, and as the company's business has largely increased in previous years it hopes for a like increase during the present year.

The Buckeye Engine Company has taken out a charter under the laws of New Jersey, capital stock $1,000,000. It is stated that this does not affect the external relations of the company or denote any important change of policy. The company's works at Salem, Ohio, have been increased in capacity about 50 per cent. in the last eighteen months. The number of orders on the books, as figured lately, was greater than ever before—comprising 194 engines, a considerable number being large ones. Recent orders booked in this territory call for two engines of 375 kilowatts each for the Crucible Steel Works at its plant in Jersey City, and two engines for the Malleable Iron Works, in Connecticut.

Within the last few months there has been talk of consolidating the crane manufacturers of the country. It is now reported that a concern for the purpose, called the United States Crane Company, will be incorporated under New Jersey laws with a capital stock of $100,000, which, if the plans of the promoters are carried out, may later be increased to $25,000,000.

Bids are in for the equipment of the marine shops of the New York, New Haven & Hartford lines at Newport, R. I. The tools required include a good many iron working and some wood working, footing up all told, it is estimated, pretty well toward $100,000.

The indications are that the Convertable Car Company of New York, to which we have referred in the past, will erect its plant at Bloomsbury, N. J. Options upon twenty acres of land have been taken. The company is capitalized at $250,000, and purposes to expend half this amount in the erection and equipment of the factory.

The Mount Vernon (Ill.) Car Manufacturing Company made a voluntary wage increase of from 10 to 15 per cent. to its employees, April 1.

Should the Schoen pressed steel car-wheel experiments to be conducted at the works of the Bethlehem Steel Company, to which we referred last week, prove successful, a plant to cost $7,000,000 may be erected on Northampton Heights, fronting on the Lehigh Valley tracks.

The machinery manufacturers of Worcester, Mass., are reported to have held a more or less general gathering and discussed the labor situation, the sentiment of the meeting being that if the machinists repeated last year's demands the manufacturers should hold their ground and rather than yield allow their plants to be closed down, notwithstanding the pressure of orders.

We mentioned last week that the old firm Dexter Harrington & Son, in Southbridge, Mass., are incorporating and intend to build a new plant. The firm send us the additional information that their new name will be Harrington Cutlery Company.

The Mason Machine Works, Taunton, Mass., have received an order from M. C. D. Borden for 84,000 spindles and 2,400 looms to be used in his new mill in Fall River. The machinery must be ready for setting up by July 1.

The past week has brought renewed rumors and denials of closer relations between the General Electric and Westinghouse Electric companies.

The Pneumatic Signal Company, with office in New York city, has purchased the Standard Signal Company, of Troy, N. Y., and is now designing new works, which will be built on the most approved lines, for the construction of all branches of signal work. This company also owns the controlling interest in the British Pneumatic Railway Signal Company of England, which has installed the first system of automatic block signals, as well as the first pneumatic interlocking system in Great Britain. The company has received further the orders for eight large low-pressure pneumatic interlocking plants and thirty-one block stations in England. It is also forming continental companies for handling its various appliances.

The contract for the Machinery Building, one of the nine big exhibit buildings of the St. Louis Fair, has been awarded by the Louisiana Purchase Exposition Company, to Smith & Eastman, a general contracting concern, for $496,957. A dozen other firms put in bids for the work. The dimensions of the structure are to be 525 by 1,000 feet. It will be crowned by eleven towers, two of which, each 285 feet high,

flank the northern entrance. The building will house the big electric light and power plant to be put in by the Westinghouse Electric Company. The architects of the Machinery Building are Widmann, Walsh & Boisselier, of St. Louis. The next building to be let will be the Liberal Arts Building, plans for which are about ready for contractors.

The Bullock Electric Manufacturing Company, Cincinnati, Ohio, has issued a statement denying that it contemplates negotiating the sale of its plant to its competitors or others, affirming that it has sufficient surplus to pay dividends on its preferred stock for several years if the factory were shut down to-morrow; stating that the company is a close corporation, none of the stock being owned by its competitors and a controlling interest being held by its officers and making some further statements in regard to patent litigation, etc. The following concerning the work and plans of the company is of interest: "The Bullock Electric Manufacturing Company is now building machines up to 3,200 kilowatts and have their machine shop No. 3 now under construction and well on towards completion. This will add facilities to the plant which will make possible the building of machines in units as large as 10,000 kilowatts capacity. . . . The success of the Bullock Electric Manufacturing Company in building both direct and alternating current machinery and its rapid growth has been phenomenal and the Bullock company is in business to stay."

The following interesting news was received from the Westinghouse Companies too late for insertion in our last number: Two important contracts for railroad shops have been secured lately by Westinghouse, Church, Kerr & Co., including complete generating plants as well as motor equipments. This apparatus will be installed in the new shops of the Union Pacific Railroad Company, at Omaha, and the Oregon Short Line Railroad Company, at Pocatello, Idaho, and will consist of Westinghouse machines throughout—engines, generators and motors. It is proposed to adopt direct-driven tools wherever possible, as it is believed that under this plan the best results can be obtained, everything considered. The equipment for the Union Pacific Company's new shops at Omaha will contain two compound engines directly connected to 250-kilowatt 250-volt engine type generators and one compound engine directly connected to a 75-kilowatt 250-volt generator. The contract also covers twenty-one shop motors ranging from 5 to 25 horse-power. The Oregon Short Line contract includes two Standard engine type outfits for direct connection to 150-kilowatt 250-volt generators and one Junior engine for direct connection to one 50-kilowatt 250-volt generator, also twelve shop motors.

CHICAGO MACHINERY MARKET.

No matter how wide the inquiry is extended, there is but one report concerning the present state of the machinery trade. It is satisfactory, to make a conservative statement. From store there are the usual daily and weekly fluctuations, alternately brisk and quiet, but the footings are the figures that bring consolation. The Santa Fé road about a week or two ago closed a contract for the machinery equipment for new shops at Topeka, the bulk of the business, it is understood, going to the Niles-Bement-Pond Company. But aside from this transaction the current trade is made up mainly of detached and comparatively unimportant orders. One local seller says that one day last week he shipped two carloads of tools, this aggregate going to nineteen buyers, usually in lots of one or two machines each. The extent of the buying occasions much wonder among sellers, it being beyond all precedent, and can apparently be accounted for only on the theory that general manufacture is increasing by leaps and bounds beyond the comprehension of the average business man. And one beauty about it all is that trade is more than ever before on a cash basis. There are few or no requests for time payments or for the acceptance of notes. A few little shops are springing up constantly, but the great bulk of the machine tools is entering the shops of old concerns.

A prominent seller of wood-working machine tools says that most of his sales are to furniture and manufacturing factories. The building trades are not yet particularly active. Many of his customers, he says, are making money so fast that they do not know just what to do with it. By and by they will put it into building lots. Then will come the real estate boom, with its speculative following, till credits begin to lengthen with the usual ultimate results. But augury or not, there is now nothing in sight to forecast any dire consequences of that nature. It is remarked that very few machines are being exchanged, buyers either holding to the old tools for emergency use or putting them into scrap.

Machine-tool factories are reported to be oversold with few if any exceptions. One large seller, familiar with conditions both East and West, says business is 50 per cent. larger than a year ago and that it has never been better within twenty years. There is a tendency for prices to advance. Milling machines were some time ago marked up by some makers about 5 per cent. One maker is reported to be sold up to next September, and another is now booking orders for December delivery. There may be exceptions to the oversold condition, but the general tone of the market indicates activity at factories.

Kearney & Trecker, Milwaukee, are sold far ahead on milling machines and are running at full capacity. The American Wood Working Machine Company is adding a large extension to its plant at Aurora, Ill.

Quotations.

NEW YORK, Monday, April 14.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$20 15 @ $20 65
No. 2 X	19 65 @ 20 15
No. 2 plain	19 15 @ 19 65
Gray forge	18 65 @ 19 15

Alabama Pig, New York delivery:

No. 1 foundry, or soft	16 25 @ 19 25
No. 2 foundry, or soft	15 75 @ 18 75
No. 3 foundry	15 25 @ 18 25
Foundry forge, or No. 4	14 75 @ 17 25

The minimum quotations given above on Alabama irons are nominal. The actual price is somewhere near the maximum quotations.

Bar Iron—Base sizes—Refine' brands, mill price on dock, 1.93c. in carload lots. Smaller quantities from store, about 2.10c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Sheel—Base sizes—From store, 2.00 @ 2.10c.

Cold Rolled Steel Shafting—Base sizes—From store, 2¾c.

Copper—Lake ingot, 12 @ 12¼c.; electrolytic, 12 @ 12⅛c.; casting, 11¾ @ 12c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 28¼c.

Pig Lead—4.10 @ 4.12½c. in 50-ton lots.

Spelter—4.35 @ 4.45c., New York delivery.

Antimony—Cookson's, 10 @ 10¼c., according to quantity upward from one cask; Hallett's and U. S., 8 @ 8⅛c.; various brands, 7¾ @ 8c.

Lard Oil—Prime City, 79 @ 80c., according to brand and quantity.

New Corporations.

Empire Wire Co. of New York; capital, $100,000.

Houser Elevator Co., of Syracuse, N. Y.; capital, $50,000.

Buffalo Pitts Steam Roller Co., of Buffalo, N. Y.; capital, $125,000.

Strong Machinery & Supply Co., of New York City; capital, $50,000.

The Union Steel Casting Co., Pittsburgh, Pa., has increased its capital stock from $150,000 to $200,000.

Pennsylvania Engineering Works, New Castle, have increased their capital stock from $225,000 to $500,000.

New Catalogs.

The Varley Duplex Magnet Company, Phillipsdale, R. I., manufacturer of electro-magnets and all kinds of coil windings of insulated and bare wire, publishes a catalog of telephone and other magnets, induction coils, gas engine coils, etc. The American Electric Works, Providence, R. I., are general sales agents for the company throughout the United States. The catalog is 7x5⅛ inches.

Record of Recent Construction, No. 32, of the Baldwin Locomotive Works, Philadelphia,

Pa., is entitled "Seventy Years of Locomotive Building." It gives a view and description of "Old Ironsides," the first locomotive built by Matthew W. Baldwin, but is more extensively concerned with the modern compound locomotives of the company. The pamphlet is 9x6 inches, standard size.

Chas. A. Shieren & Co., 49 Ferry street, New York, have sent us a priced catalog of pure oak-tanned leather belting and lace leather, as well as cotton and rubber belting, raw-hide rope, belt dressing, cement, oil, punches, hooks, leather gaskets, etc. Not the least interesting feature is a chapter of illustrations showing some large belt drives in operation. The catalog is 6x9 inches, standard size.

The Cox & Sons Company (works, Bridgeton, N. J., and office and warerooms at 215 Race street, Philadelphia), has sent copies of its catalog of pipe-threading and cutting-off machines, an extensive line of portable forges, improved vertical and Corliss engines, etc. The company is also a manufacturer of air compressors, gas producers, gas and oil melting tanks and oil fuel apparatus. Size of page, 9½x6 inches.

The Sawyer Tool Manufacturing Company, Fitchburg, Mass., has brought out a new edition of its catalog of fine tools and hardware specialties. There is shown an assortment of steel rules, squares and gages of different sorts, inside micrometers, tap and reamer wrenches, machinists' hammers, screwdrivers, center-punches, the Prouty valve wheel, etc. A new feature is the prices of parts of combination squares, etc., given on page 50.

R. D. Wood & Co., 400 Chestnut street, Philadelphia, Pa., send us a catalog (6x9⅜ inches) illustrating and describing a line of centrifugal pumping machinery. A number of pages of tables are included and a chart of capacity, lift, efficiency and power, for determining any of these elements when the other three are known. They send another catalog (8⅜x11 inches) of cast-iron pipe, valves and apparatus for water and gas works.

The Reeves Pulley Company, Columbus, Ind., has brought out a revised edition of a pocket memorandum book containing, besides 100 double-ruled blank pages, some information useful especially to such as have to do with the installation and operation of the Reeves variable speed transmission. Several pages have been added, containing matter of exclusive interest to the paper mill industry. The company makes a charge of 15 cents for the book, post paid. It is 2¾x5¾ inches in size.

The Putnam Tool Company, Fitchburg, Mass., has published a 1902 catalog of the new Putnam automatic cut-off poppet valve steam engine. A table of standard dimensions of the engines, which is given, embraces cylinders of 9x21 inches to 36x54 inches. Pains have been taken to describe the engine more fully than ever before and to ensure the accuracy of illustrations. The catalog contains directions for attaching the regulator and setting the valve, besides other information. Size of pamphlet, 6x9 inches, standard.

We have received a copy of the 1902 machinery catalog of Blake & Johnson Waterbury, Conn. It shows a line of rolling mills and of slitting machines, presses, rivet machines, wire nail machines, bicycle machinery, thread rolling machines, and other special machinery for making wire and small metal goods, gas fixture parts, furniture nails, etc. The firm makes not only machinery, but pins, rivets, wire goods, etc. There is also shown a line of vertical milling machines of different sizes. The catalog is a fine publication and is 6¾x9 inches.

A fine catalog has been sent us by the Cincinnati (O.) Milling Machine Company, devoted to the company's well-known lines of plain and universal milling machines and cutter and tool grinders. Especial pains have been taken with the illustrations and with the introductory description of features. A good variety of miller attachments are offered, including the universal indexing and dividing heads, special spiral cutting head, plain indexing centers, under-cutting arrangement, vertical spindle milling head, universal milling attachment, rack-cutting attachments, cam-cutting attachment, rotary milling attachment, high-speed milling attachment, high tailstock, new milling machine dog, etc. The pamphlet is 6x9 inches, standard size.

Manufacturers.

The Corning (N. Y.) Cut Glass Company is to build an addition.

The plant of the Robertson Paper Company, Bellows Falls, Vt., will be enlarged.

F. W. Bird & Son, paper manufacturers, East Walpole, Mass., are building a new mill.

The Silver City Plate Company, Meriden, Conn., is having plans made for a new building.

The Chief Husker & Shredder Company, Newcastle, Ind., will locate its factory at Colfax.

The Detroit (Mich.) Range Boiler Company will erect an additional building, 105x110 feet.

The contract has been let to build the Santa Fe shops at San Bernardino, Cal., at a cost of $107,000.

The East Jordan Lumber Company at East Jordan, Mich., is erecting a factory for surfacing lumber.

H. C. Ball & Co., Philadelphia, manufacturers of worsted yarns, will build a boiler and storage house.

The Interstate Clay & Mineral Company (offices in Builders' Exchange, Philadelphia) will build a plant.

A second story is to be added to the factory of the Columbian Jewelry Company, West Somerville, Mass.

David Pobolinski & Son, Worcester, Mass., manufacturers of underwear, are to build a factory 100x50 feet.

The Morrill Knitting Company, of Woonsocket, R. I., will build a 100-foot addition to its plant in that city.

Pratt, Read & Co., Deep River, Conn., ivory works, have begun the addition of two stories to their south L wing.

The New Martinsville (W. Va.) boiler works have secured a site and have about started to build their shops.

A Chicago building permit has been granted to W. S. Cumming for a foundry at 1121 West Twenty-first street, to cost $4,000.

The Reed Manufacturing Company, manufacturer of tinware, Newark, N. Y., will build a new $30,000 factory this summer.

The new mill to be erected by the Reading (Pa.) Iron Company will be used to manufacture pipe as large as 20 inches.

There seems to be a probability that the plant of the Currie Windmill Company, Topeka, Kan., will have to be enlarged.

Daniel Harding, of Towson, Md., has been awarded the contract for building an ordnance shop at Fort Washington, Md.

William B. Shafer, promoter, of Nazareth, Pa., proposes to build a cement mill along the Delaware River, near Martin's Creek.

The Bradley & Hubbard Manufacturing Company, manufacturer of gas fixtures, Meriden, Conn., intends to erect additions.

The foundation walls for the Coulter & McKenzie Machine Company's new shop at Bridgeport, Conn., have been commenced.

The Wisconsin Chair Company, of Port Washington, Wis., has given its employees a voluntary increase in wages of 10 per cent.

A permit has been granted for building a rear addition to the Greth Machine Works, Franklin street, above Sixth, Reading, Pa.

It is rumored that the Streeter-Alvin Manufacturing Company, buckets and bucket machinery, South Hingham, Mass., will rebuild.

An additional story will be built to the factory of the Northwestern Foundry & Supply Company at No. 1645 Orleans street, Detroit, Mich.

An addition, 13x32 feet, is being built to the factory of the Hoggson & Pettis Manufacturing Company, die sinkers, New Haven, Conn.

The McClintic-Marshall Construction Company, of Rankin Station, Pa., will enlarge its Pottstown plant, increasing its capacity 25 per cent.

The Hay-Todd Manufacturing Company, of Ypsilanti, Mich., manufacturer of underwear, will erect a new factory in Detroit, it is understood.

The Maine Furniture Company proposes erecting a plant at Chelsea, Mass. George H. Buck was instrumental in bringing this concern to Chelsea.

A Philadelphia building permit has been granted for a factory building, to cost $18,000, for W. & R. Ford, manufacturers of yarns and waste.

The Sun Manufacturing Company is about to take out a permit for a four-story factory building at Harrisburg, Pa. The product will be textile fabrics.

The Cedar Valley Manufacturing Company, Waterloo, Ia., manufacturer of bank and store fixtures, sashes, etc., has decided upon an addition to its plant.

Worth Brothers Company, manufacturer of steel plates, Coatesville, Pa., has broken ground for its new mill. This mill will employ about 1,000 men.

Ocorr & Rugg Company, Rochester, N. Y., manufacturer of sashes, doors and blinds, has taken out a permit to build a three-story brick manufacturing building.

The Bainbridge Cotton Oil Company, E. P. McBurney, of Atlanta, Ga., president, has made application for a charter. The plant will be located at Bainbridge, Ga.

The Rochester & Eastern Electric Road Company has made a proposition to Canandaigua, N. Y., in regard to the location there of the power plant and car shops.

The New York Central & Hudson River Railroad has taken out a permit to build at Rochester, N. Y., an addition to engine-house, shop, store-house and boiler-room.

The United States Drawn Steel Company is moving its plant from Buffalo to Port Huron, Mich., and its name will there be the Port Huron Steel & Screw Company.

A permit has been issued for a two-story $9,436 furniture factory, 75x100 feet, with a wing 13x36 feet, at 118 West Allen street, Philadelphia, Pa., for Jacob Behrend.

An eight-grinder pulp mill is proposed to be erected at Glens Falls, N. Y., the promoters of the industry being Finch, Pruyn & Co., of that place. It will go by water power.

The Elk Rapids (Mich.) Iron Company is erecting a woodenware plant for the manufacture of maple flooring, mattress frames, etc. The main building will be 60x200 feet.

The Atlantic (oil) Refining Company, Philadelphia, Pa., has taken out permits for

the erection of three cooper shops and a storage shed at its works at Point Breeze.

It is thought that the Edgar Thomson Steel Works may soon shut down in part for a few days to make some repairs, including the installation of a new engine at the rail mill.

The property and effects of the Reeves Machine Company, Trenton, N. J., have been purchased by the Reeves Engine Company, which will continue to conduct the business.

The plant of the Fitzgibbon & Crisp Carriage & Wagon Company, of Trenton, N. J., is expected to be enlarged. It is reported to have been brought into a consolidation with others.

John A. Waters & Co., Inc., of Richmond, Va., are to fit up with modern machinery a plant in Manchester, Va. It is understood that their line of work will be engines and boilers.

The National Construction Company, of Detroit, Mich., has the contract to erect a beet sugar plant at Charlevoix. There will be an annex for boilers, etc., and a machine shop, 25x60 feet.

The Massachusetts Cotton Mills, Lowell, Mass., will build a $600,000 addition to their establishment at Lindale, a suburb of Rome, Ga. A 2,000 horse-power engine will be put in the mill.

Work is about being started on raising the roof of the main factory of the Wheeler & Wilson Manufacturing Company, Bridgeport, Conn., sewing machine manufacturer, two stories higher.

Architects Sparrell & Starr, of Benton Harbor, Mich., have prepared plans for a brick and stone factory building, 300x350 feet in size, for De Witt & McConnell; estimated cost, $100,000.

It is reported from Amsterdam, N. Y., that the Magneto Electric Company has awarded the contract for the steel work for the first factory to be built to the Kellogg Iron Works Company, of Buffalo.

Capt. Ed J. Howard & Sons, of Jeffersonville, Ind., have purchased the plant of the Mound City Marine Railway & Dock Company, at Mound City, Ill. They will enlarge the plant and build steamboats there.

The B. F. Lee Constructing Company, Wilkinsburg, Pa., has begun excavations for a new plant at Rankin. Planing mills and other wood-working shops will be built this spring, which will employ from 300 to 400 men.

Ground has been broken at Port Richmond, Cal., for the new machine shops of the Santa Fe Railroad Company. The building will accommodate 500 workmen. At present 200 mechanics are employed in the temporary shops at that place.

The transfer of the Bellingham Bay Iron Works, Whatcom, Wash., to the Whatcom Machinery Depot has been completed. The new company will enlarge the plant. The manufacture of heavy machinery will be a special feature of the company's work.

Griffin, Ga., is to have another cotton mill, which will be known as the Boyd-Mangham Manufacturing Company, and will make fine goods. Contracts have been let for most of the building material, and a large part of the machinery, which calls for 10,000 spindles.

O. A. Byrons has arrived in Independence, Kan., from Holland, Mich., and assumed his position as superintendent of construction at the sugar plant of the Adamson Manufacturing Company. Excavation has begun for the engine-room and machine shops at the factory.

A permit has been issued for a factory addition to the plant of the Baldwin Locomotive Works, on Broad street, near Hamilton, Philadelphia, Pa. It will be a six-story and basement structure, 50x58.6 feet, of steel construction and will cost $20,000. Plans are by George Allen Glass.

The burned foundry of the Rock River Machine Company, Janesville, Wis., will be rebuilt. Several large machines are being placed on the first floor of the warehouse where the machine shop will be located. Some smaller machines will be placed on the second floor of this building.

The Danielson Worsted Company, which has recently been organized, will manufacture woollens and worsteds in Danielson, Conn. Shop property has been purchased and will be equipped with new machinery. Cassius S. Chase and Frank Casey will be the active managers of the enterprise.

C. S. Horton, acting president, and C. B. Farr, vice-president of the Barclay Railroad Company, have been inspecting available sites for the location of the sawmill which will manufacture the lumber on the tract along the Schraeder Creek of the Union Tanning Company, Williamsport, Pa.

The H. W. Johns-Manville Company, of New York and Milwaukee, will build an asbestos mill in the Menomonee valley, two stories, 75x300 feet. The company has just obtained a contract to provide $300,000 worth of asbestos for the Pacific Oil Company in the California oil fields.

The Sharon (Pa.) Steel Hoop Company has awarded the contract to the Columbia Bridge Company, Carnegie, Pa., for an open hearth steel plant, and will expend $1,000,000 in improvements and additions, making the plant one of the largest independent steel hoop and cotton tie factories in the country.

The Buffalo Pitts Steam Roller Works, Buffalo, N. Y., has been incorporated, with a capital stock of $125,000. The company intends to manufacture road rollers and engines, as well as import and export the same. The directors are Carlton Sprague, Charles M. Greiner and Henry S. Cunningham.

The charter of the Brookhaven (Miss.) Cotton Oil Company has been published, with E. A. Moreton, W. H. Seavey and D. J. Batchelder, Jr., of the county, and others as incorporators. The capital is $50,000. Steps will be taken to erect an oil mill of 80 tons daily capacity, together with a fertilizer factory.

The Oakland Woolen Company, Oakland, Me., is being organized to establish a plant. A local machine company has agreed to sell its location and water power. A committee consisting of H. W. Greely, M. S. Holmes, Hiram Winslow, Morrison Liby and Ed. Harris was chosen to solicit subscriptions for the new mill.

The dam of the James Ramage Paper Company at Monroe Bridge, Mass., which has been gradually going to pieces since damaged by the big freshet in March, has given way and the machinery swept out into the river has disappeared. The company will rebuild at once. The mills on the Monroe side of the river are not badly damaged.

The Morden Manufacturing Company, of Gananoque, Ont., manufacturer of office files, etc., is building additions. The new buildings will include a machine shop and metal factory, two stories, 72x27 feet; boiler-house, 21x27; fan-room, 22x19, and dry kiln, 20x80, in four compartments. The machine shop will later be extended to 40 feet in width.

The Allied Securities Company has just been incorporated with $2,000,000 capital, an amount which may be increased later to $25,000,000, and hopes to acquire all the large woven wire concerns in the country. It has already obtained what seems to be a controlling interest in the Page Woven Wire Fence Company, of New Jersey, a concern capitalized at $8,000,000.

The Nittany Iron Company has been formed at Bellefonte, Pa., by J. W. Gephart, L. T. Munson and Frank H. Clemson, of that place, and Archer Brown and William Sampson, of Rogers, Brown & Co., and has purchased the plant of the Valentine Iron Company, including furnace, rolling mill, four ore mines and thousands of acres of ore lands and rights. The price paid was $85,000, and the plant will be put in operation June 1.

News comes from Tamaqua, Pa., that work is beginning on the construction of the Red Ash breaker at No. 6 workings of the Lehigh Coal & Navigation Company, Philadelphia, Pa. The work on the White Ash breaker is about completed and the machinery is being placed in position. It is reported from Mahoney City, Pa., that the Crystal Run Coal Company has awarded a contract for the erection of a breaker at Frackville to cost $40,000. It will employ 600 men and boys.

A new manufacturing concern has been organized at Niagara Falls, N. Y., which will start business with a capital of $70,000. It is known as the Frontier Manufacturing Company and will manufacture extension ladders and extension ladder locks and general fire apparatus. The directors named in the incorporation are Carl Steinbrenner, proprietor of the big Steinbrenner lumber mills; Walter Steinbrenner, Walter Binkley, George W. Knox and H. A. Constantine.

The Hale & Kilburn Manufacturing Company, furniture, car seats, etc., has decided to move its plant from Sixth avenue and Arch street, Philadelphia, Pa., to a tract of land, 750x200 feet, near Germantown Junction. A set of buildings will be erected, having about 250,000 feet of floor area, and these will include lumber drying sheds, large dry kilns, a complete wood-working mill, cabinet shop, finishing room, spring department, upholstery department, stained glass department, machine shop, forge shop, storehouse, wareroom, dining-room and kitchen, offices, stable and power-house. About 300 horse-power will be developed and distributed in an alternating electric current. The machines will probably be driven in groups, belting off from electrically driven shafts.

With the listing of the securities of the Railway Steel Spring Company on the New York Stock Exchange a detailed statement has been presented. The authorized and outstanding capital is $20,000,000, equally divided between common and preferred stock. The latter is 7 per cent. cumulative. The capacity of the different works in the combination is as follows: A. French Spring Works, 15,000 tons; Chas. Scott Spring Works, 15,000 tons; Pickering Steel Works, 10,000 tons; National Railway Spring Works, 8,500 tons; Detroit Steel & Spring Works, 20,000 tons; also steel mill with capacity of 40,000 tons, and railway spring department of Crucible Steel Company of America, 5,000 tons. The aggregate net earnings of these properties were as follows in the years mentioned: In 1899, $1,002,182; in 1900, $1,094,452; in 1901, $1,299,565; total, $3,396,200; average net earnings per year, $1,132,066.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.
Punches & dies. Wal.M.Wks., Waltham, Mass.
Stamping dies. Emmons Collins, Chicago.
Caliper cat. free. E. G. Smith, Columbia, Pa.
Patterns and models. 19 Thames st., N. Y.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa., build light machinery.

Will pay 25c. for single copy of AMERICAN MACHINIST, July 5, 1900. E. J. Mason, 52 Water st., Pittsburgh, Pa.

Special tools, models, fine light mach'y and foundry work wanted. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

For Sale—U. S. patent 696309, "Multiple Lathe Gage," of interest to lathe builders. E. J. Bowers, 2125 Ontario st., Philadelphia.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

Special tools, models, fine light machinery, experimental and electrical work wanted, also specialties to manufacture. The General Mfg. Co., 40 West 13th st., New York City.

Machinery designed, mechanical drawings, blueprints, plans for power-houses, power transmission; 20 years' experience. "Engineer and Draftsman," Box 344, AM. MACH.

Partner wanted, or will lease or sell a good paying machine shop in New York; account ill health of proprietor; plenty of work on hand. Address Box 360, AMER. MACHINIST.

Wanted—Contract work for 34 in. x 8 ft. planer, 32 in. lathe raised to 48 in., 20 ft. between centers; also full line of smaller tools; also first-class foundry. Box 298, AM. MACH.

Wanted—Capitalists or manufacturers to join me in patenting and developing several valuable inventions; have taken years experimenting on them, but have no capital. Box 383, AMERICAN MACHINIST.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

For Sale, Cheap—Two colored tool tempering charts, explaining all tempering to a standard, in oil, water or tallow, making all tools with hard, tough edge, and 40 new steel-working receipts; all for $1. W. M. Toy, Sidney, O. (40 years a factory steel worker).

To makers of plain and universal milling machines, brass working machinery, boring and turning mills and bolt-cutting machines—An English firm of machinery importers desires to communicate with above, with a view of arranging exclusive agency for Great Britain. Address Box 335, AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Position as foreman or superintendent; A1 references. Box 368, AMER. MACHINIST.

Toolmaker, 25, 7 years' experience, dies, jigs, etc.; references. Box 361, AMER. MACH.

Cost accountant, experienced, thoroughly competent, latest system, wishes change. Box 376, AMERICAN MACHINIST.

Designing draftsman and toolmaker, 20 years' experience, desires responsible position. Box 372, AMERICAN MACHINIST.

Die and toolmaker of wide experience on small work wishes a position with telephone company; can take charge. Box 378, AM. M.

Graduate draftsman wants position; mechanical work only; references. "Mechanical," care AMERICAN MACHINIST.

Mechanical engineer, 33, with extensive experience in constructing, desires well-salaried position in New York or vicinity. Box 350, AMERICAN MACHINIST.

Mechanical engineer, graduate, extensive experience in gasoline engines and automobile, seeks responsible position. Address "Auto," care AMERICAN MACHINIST.

Machinist, 10 years' experience, also draftsman, technical education, had charge of men, wants position with chance to advance; age 34. Box 382, AMERICAN MACHINIST.

Responsible position wanted by expert on automatic machinery; draftsman, engineer, superintendent; 10 years' experience; age 31; technical graduate. Box 364, AM. MACH.

Machinist and toolmaker, experienced drafting, developing ideas, handling help, 30 years old, ambitious, wants position of some responsibility; references. Box 367, AM. M.

A young Dane, just arrived from Denmark, wants a position as machinist in New York city or vicinity; has learned the trade and speaks English. Address Box 385, AM. MACH.

I wish to identify myself with a manufacturing concern as engineer or chief draftsman; I have a few thousand dollars to invest if favorable opportunity offers. Box 380, AMERICAN MACHINIST.

As superintendent and mechanical engineer; now holding like position, building high-speed automatic and Corliss engines; up-to-date designer; good executive ability. "Output," care AMERICAN MACHINIST.

A mechanical engineer, now engaged in New York city, desires a position in charge of rate fixing, in or near Buffalo or Cleveland; experienced in handling men and determining accurate shop costs. Box 377, AM. MACH.

Man of ability, with experience at designing and constructing standard and special machinery and tools for metal-work manufacturing; reliable firm in Middle West preferred. Box 363, AMERICAN MACHINIST.

Position as foreman wanted, by thorough machinist and toolmaker, used to building high-grade work by the interchangeable system; up-to-date tools and fixtures designed. Address Box 359, AMERICAN MACHINIST.

Position as superintendent or foreman, by practical mechanic, up to date in modern methods, organizing and the handling of men to obtain best results; interchangeable machinery and specialties. Box 348, AM. M.

Wanted—Position as superintendent or general foreman, by man of extensive experience on special and automatic machinery, tool building and gas engine work, now holding position as superintendent; up to date and a hustler. Address Box 384, AM. MACH.

Engineer, mechanical and electrical, desires change; experienced in power plant design, erection and operation; competent on any kind pipe work; been in charge general factory work several large plants; very well acquainted with shop costs and methods. Box 375, AMERICAN MACHINIST.

Position desired by technical graduate, international training, age 32; 10 years' experience devising and superintending construction of machinery and the manufacture of small parts on interchangeable lines; at present in Germany; good handler of help. Address Box 332, AMERICAN MACHINIST.

If you make duplicate castings in quantities, and need a superintendent or assistant capable of introducing money-making methods of molding and patternmaking, this is your chance to secure a young man, technical, patternmaker by trade, adept at light foundry practice, experienced especially in design and operation of molding and foundry conveying machinery. Box 362, AMER. MACH.

Position, preferably near New York, as superintendent or master mechanic; energetic, 35, shop and theoretical training; good organizer and manager of men; machine tools, special automatic and hydraulic machinery; well posted in modern manufacturing methods, interchangeable gage and jig work; at present M. M. of plant having 2,500 horsepower in steam and hydraulic machinery; good reasons for changing; A1 references from present employers and others. Box 373, AMERICAN MACHINIST.

Help Wanted.

Wanted—25 good machinists and toolmakers. Apply Box 365, AM. MACHINIST.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

We are enlarging our plant and would like applications from first-class machinists. Box 340, AMERICAN MACHINIST.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

Six first-class molders for Corliss engines and other heavy machine castings. Address "Manufacturer," care AMER. MACHINIST.

Wanted—Patternmaker; wood only; mostly small work; permanent position; state wages expected. "Worcester County," care AM. M.

Wanted—Mechanical draftsman with some experience on tools and jigs preferred; state age and salary expected. Address "Hypo," care AMERICAN MACHINIST.

Wanted—Two first-class instrument makers; must be capable of doing very accurate work on small movements. Box 379, A. M.

Wanted, as chief draftsman, a man thoroughly experienced in the design of simple and compound engines. Box 336, AM. MACH.

Machinists wanted to act as shop agents and sell small tools where they work. Address E. H. Randall, 235 Woodland ave., Springfield, Ohio.

Wanted—A few mechanical draftsmen for tool and fixture work; state age, experience and salary; permanent positions to good men. Address Box 355, AMERICAN MACHINIST.

Wanted—Foundry foreman for Middle West, in healthy locality, in foundry employing 75 men; applications wanted from first-class men only. Address Box 288, AMER. MACHINIST.

Wanted—Several A1 mechanical or electrical draftsmen; send references and state salary expected. Apply to Engineer, Drafting Dept., General Electric Co., Schenectady, N. Y.

Large concern manufacturing machinery desires a storekeeper, also a timekeeper. Only thoroughly competent and experienced persons need address with full particulars. Box 374, AMERICAN MACHINIST.

Wanted—First-class tool and die maker; must understand the laying out of dies; steady position for first-class man. State wages and where last employed. Address Box 370, AMERICAN MACHINIST.

Wanted—Superintendent for manufacturing plant; must be accustomed to shop management; man with experience in building large valves preferred. State experience and wages desired. Box 366, AMERICAN MACHINIST.

Salesman wanted to sell tool steel; only first-class man, thoroughly conversant with the line and established trade; good salary and permanent position to right party. Apply, with references, "Express," care AMER. MACH.

Machinists Wanted.—We need 30 lathe hands and 20 planer hands for night gang on heavy machine tool work; to work 12 hours per night, five nights per week; good pay to good men. Apply to The Pond Machine Tool Co., Plainfield, N. J.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Foreman for small machine shop; one who understands die and other work and is willing to get in and hustle with the rest of the men; good position for the right man. State wages expected. Address Box 371, AMERICAN MACHINIST.

Engineers, firemen, machinists and electricians, send for 40-page pamphlet containing questions asked by Examining Board of Engineers to obtain engineer's license. Address Geo. A. Zeller, Publisher, Room 590, 18 S. 4th st., St. Louis, Mo.

Wanted—Two or three good draftsmen; none but those having had experience in building and designing machine tools and fixtures need apply; state age, experience and references. Address Chief Draftsman, Pratt & Whitney Co., Hartford, Conn.

Wanted—A first-class mechanical draftsman to work in New York city; preferably one experienced on heating furnaces for mechanical purposes; applicants must give references, experience and salary expected. Apply Box 346, AMERICAN MACHINIST.

Wanted—First-class designer and draftsman on labor-saving tools; character of machinery and tool to be brought out are for brass and iron valves and iron pipe fittings. State age, experience and salary expected. Box 364, AMERICAN MACHINIST.

Wanted—As assistant superintendent in a foundry and machine works in vicinity of New York, a technical graduate with considerable shop and drawing-room experience. Address, stating full particulars and salary expected, "Manager," Box 672, New York.

Wanted—Thoroughly competent foreman on machine tool building, experienced in building pipe threading machinery, familiar with methods of producing duplicate parts on turret lathes; give age, experience, salary expected and references. Box 237, AMER. MACH.

Wanted—First-class man who understands boring and drilling and the building of small foot and power presses; good steady position for the right man. Shop located in New York city. State wages and where last employed. Address Box 369, AMER. MACHINIST.

Wanted—Thoroughly competent foreman for automatic and hand screw machine department; must be familiar with Cleveland and Hartford style of automatic screw machines and capable of turning out accurate work; give age, experience, salary expected and references. Box 381, AMER. MACHINIST.

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Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Balls, Steel

Automobile & Cycle Parts Co., Cleveland, O.
Grant Tool Works, Franklin, Pa.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Sure Grip Mfg. Co., Phila., Pa.

Belt Lacing Machines

Diamond Drill & Mach. Co., Birdsboro, Pa.

Bending Machines, Hydraulic

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Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
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Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
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Blue Printing Machines
Pittsburgh Blue Print Co., Pittsburgh, Pa.

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Phila. Pneumatic Tool Co., Philadelphia, Pa.

Drilling Machines, Portable
Ballett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
Amer. Tool Wks. Co., Cincin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Fosdick & Holloway M. T. Co., Cincinnati, O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
Am. Tool Wks. Co., Cincinnati, O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Sibley & Ware, South Bend, Ind.
Snyder, J. E., Worcester, Mass.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mgf. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Knobbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Elec. Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Akron Elec. Mgf. Co., Akron, O.
General Elec. Co., New York.
General Incan. Arc Light Co., New York.
Triumph Electric Co., Cincin., O.
Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.
Whiting Fdry. Equipment Co., Harvey, Ill.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.

Engines, Gas and Gasoline
Charter Gas Engine Co., Sterling, Ill.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Pierce-Crouch Engine Co., New Brighton, Pa.
Regal Gas Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Stover Engine Works, Freeport, Ill.
Struthers, Wells & Co., Warren, Pa.
Weber Gas & Gasoline Eng. Co., Kansas City, Mo.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.

Engine Stop
Consolidated Engine Stop Co., New York.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.
Flower & Co., Walter L., St. Louis, Mo.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co,. L. S., Athol, Mass.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin.,O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Son, Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Turley, J. G., St. Louis, Mo.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Molded
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gleason Mach. Works, F., Philadelphia, Pa.
Gould & Eberhardt, Newark, N. J.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Mass.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburgh Shear Knife & Mach. Co., Pittsburgh, Pa.

Handles, Machine Tool
Schacht Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.
Whiting Fdry. Equipment Co., Harvey, Ill.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Eastern Mchry. Co., New Haven, Conn.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Igniter, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Instruction Schools
See Schools, Correspondence.

Instruments, Drawing
Keuffel & Esser Co., New York.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Joints, Universal
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mach. Co., Hartford, Conn.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Gen. Incan. Arc Light Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Schwickart, Ph., Brooklyn, N. Y.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes
American Tool Wks. Co., Cin., O.
Auto. Mach. Co., Bridgeport, Ct.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Washburn Shops, Worcester, Mass.

Letters, Pattern
Butler, A. G., N. Y. City.
Racine Mchry Co., Racine, Wis.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Columbia Factory, Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Stowell, J. A., Leominster, Mass.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Electric Co., New York.
General Incan. Arc Light Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Metallic
U. S. Metallic Packing Co., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans and Tote Boxes
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Bevans, James W., Washington, D. C.
Cromwell, W. H., Washington, D. C.
Cullen, Orlan Clyde, Washington, D. C.
Frothingham, N. L., New York.
Patent Title & Guarantee Co., New York.
Stevens & Co., Milo B., Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.
Machinery Exchange, Chicago, Ill.

Patterns, Wood
Falkwill Pattern Works, Cleveland, Ohio.
Gobeille Pattern Co., Cleveland, O.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planer, Plate
Hilles & Jones Co., Wilmington, Del.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer-Eames Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.

Planers—*Continued*
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Phila., Pa.

Presses, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.

Profilers
Garvin Mach. Co., New York.

Pulleys
Cresson Co., Geo. V., Philadel., Pa.
Howard Iron Wks., Buffalo, N. Y.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburgh Shear Knife & Mach. Co., Pittsburgh, Pa.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleve., O.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Rheostats
General Incan. Arc Light Co., New York.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Roller and Ball Bearings
American Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Roller Bearing & Equipment Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Ohio State University, Columbus, Ohio.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Separators, Oil
Am. Tool & Mach. Co., Boston, Mass.
Springfield Separator Co., Springfield, Vt.

Shafts, Flexible
Chicago Flexible Shaft Co., Chicago, Ill.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegeny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Pittsburgh Shear Knife & Mach. Co., Pittsburgh, Pa.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Springs
Cleveland Wire Spring Co., Cleveland, O.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Machinery
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Straightener, Screw
Towsley Mfg. Co., J. T., Cin., O.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., The, Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Ct.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.

Tools
See Machinists' Small Tools.

Transmission Machinery
Allston Foundry Co., Boston, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Whiting Fdry. Equip. Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Trucks, Shop
Towsley Mfg. Co., J. T., Cincin., O.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
Amer. Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland O.

Valves
See Steam Fittings.

Vises, Metal Workers'
Hammacher Schlemmer & Co., New York.
Howard Iron Wks., Buffalo, N. Y.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Tee Surfacing Machine.

We illustrate herewith a new machine for facing tees, crosses and elbows. Figs. 1 and 2 show plan and front elevation of the machine, and Figs. 3 and 4 show the construction of the heads. This machine being made with three heads, will face in one operation the three flanges of a tee, the two flanges of an elbow or two flanges of a cross. The cross can then be reset and the two remaining flanges finished. The machine will handle from 6-inch to 24-inch fittings; the two heads in front taking in work from 15 to 44 inches long, and the rear head working on surfaces that extend from 7½ to 22 inches back from the center of machine. The facing tools will feed in from a 32-inch to a 6-inch circle.

The plan, Fig. 1, gives a good idea of the scope of the tool; a small cross, a medium-size elbow and a large tee all being shown in position between the heads. The small sketch in Fig. 1 shows the manner in which the cutter heads clear each other when working on small tees.

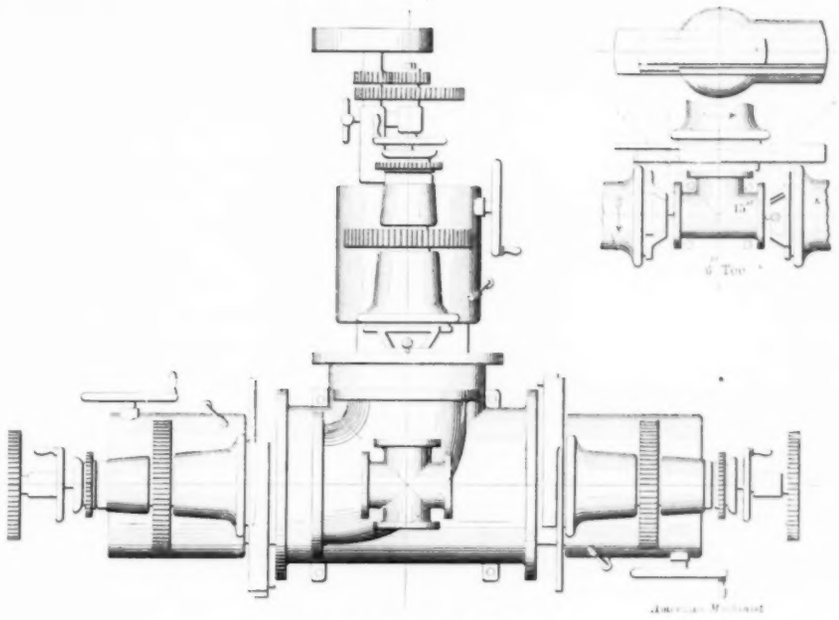


FIG. 1. TEE SURFACING MACHINE.

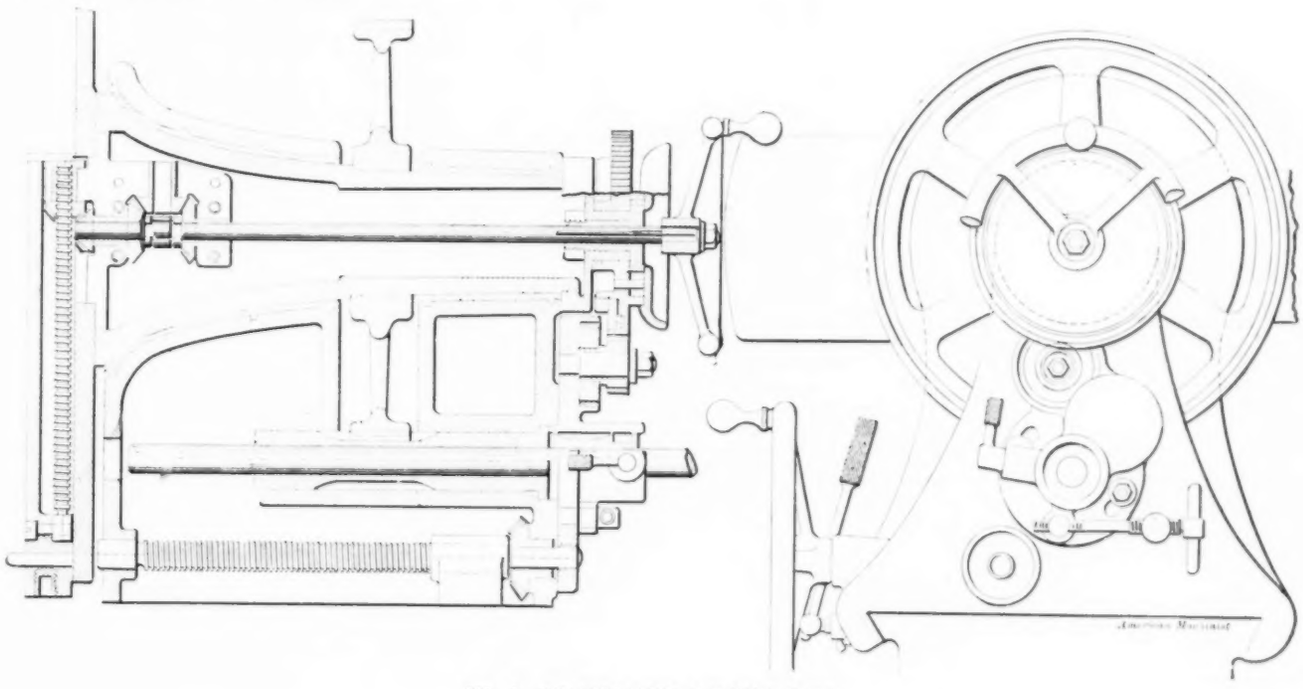


FIG. 3. TEE SURFACING MACHINE HEAD.

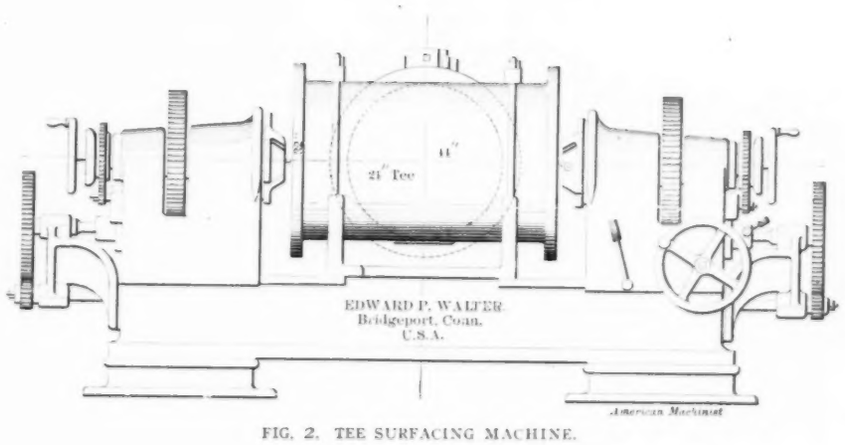


FIG. 2. TEE SURFACING MACHINE.

The three spindles and the feed gears for the cutter heads are all driven by the pulley at the rear of the machine. This pulley is driven from a constant speed countershaft. Six change gears are furnished with the machine and by changing the gear meshing with the pulley pinion six speeds can be obtained. The heads have independent adjustments on the bed; each cutter head is operated by its own train of feed gears and any one of the spindles can be stopped, if so desired, without interfering with the others.

The sectional view in Fig. 3 gives a good idea of the shape of the head and spindle, and also shows the mechanism for driving the spindle and feeding the tool across the work. The spindle, which is of "anti-

friction" form, is 14 inches in diameter at the front end and 6 inches at the rear. It is hollow and runs in anti-friction-metal bearings. The large spur gear keyed fast to this spindle meshes with a pinion cut in the sleeve which is fitted into the head directly under the gear. This sleeve is driven by the splined shaft shown running through it, and carrying on its outer end the gear—as shown in Fig. 2—by which it is driven from the main shaft of the machine. The outer end of the sleeve just mentioned is milled to form a clutch.

A sliding gear mounted in line with this sleeve is also provided with clutch teeth, and this gear, being driven by the sleeve, sets in motion the train of gearing for feeding the cutter head. If at any time it is found desirable to stop these feed gears, they can be thrown out of action by throwing the small knurled handle in front toward the right, thus sliding the gear out of engagement with the sleeve clutch. Ordinarily, however, these spur gears would be left in motion, the automatic feed being thrown out or in by means of a device mounted at the rear end of the spindle.

The shaft which is shown running through the spindle, and carrying on its outer end a hand-wheel, is driven by the spur gears at the rear end of the head. This shaft, which runs through two bevel gears carried in the bracket at the front of the spindle, can be connected by its clutch with either one of the gears. Thus it can rotate, in either direction, the bevel gear carried in the lug on the front of the bracket, and acting as a feed nut for operating the tool slide.

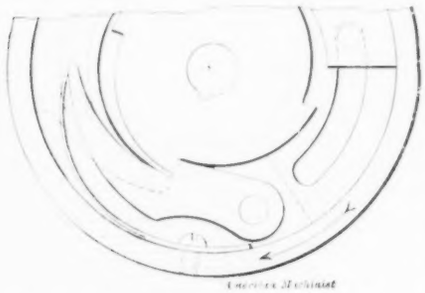


FIG. 4. AUTOMATIC FEED TRIPPING DEVICE.

If the tool is to be fed in from the outside of the flange, the hand-wheel shaft is pushed forward until its clutch engages the forward bevel gear. When the tool is to be fed out, the shaft is drawn back and connected with the gear carried in the back end of the bracket.

A safety stop is provided for disconnecting the feed whenever the cutter slide has traveled its limit in either direction.

The sectional view of the head shows the spur gear—mounted at the rear of the spindle—to be in the form of a ring held between two disks. One of these disks—shown in Fig. 4—carries a lever or dog, which is held by a spring in engagement with the four-toothed wheel keyed to the shaft. Any undue strain on the feeding mechanism will cause this gear ring to slip and operate a knock-off. This knock-off catching inside of the lever will swing it out and release the feed. If at any time the operator wishes to throw out the automatic feed and use the hand-wheel instead, he can do so by turning the saucer-shaped hand-wheel slightly ahead. This will throw the knock-out under the lever and disconnect the feed.

To start the feed again, the same hand-wheel is turned in the opposite direction, allowing the lever to drop back into place. Fig. 3 clearly shows the bracket for carrying the change and intermediate gears. It also shows the manner in which this bracket is swung up and held in its proper position.

The machine is provided with nine changes of feed, ranging from 1-32 to ¼ inch and varying by thirty-seconds. The head is moved along the bed by means of the hand-wheel shown in front and near the bottom of the head. This hand-wheel operates a screw fitted in the lower part of the head and running through a nut in a bracket fastened to the bed. The lever at the side of the hand-wheel operates a binder for clamping the head fast to the bed.

This machine is built by Edward P. Walter, of Bridgeport, Conn.

Echoes from the Oil Country.

A REVERBERATION.

Did you ever hear the story about the small bird? Somewhere in his vicinity was a great man whom he used to look on with mingled awe and delight. This great man—great at least in the view of the small bird—had a gun, a useful weapon and also a large one. With it he was able to do many things which added to the awe in which he was held by the little bird. One day the little bird felt a commotion and heard a racket, and there behold was the great man and his great gun, and the little bird had a vague idea that the gun had been aimed at him; and while he felt that he had lost a few tail feathers, he was content to let them go, taking comfort in the feeling of satisfaction that he had been of enough importance to at all attract the great man's attention, even though somewhat unfavorably.

This story came very forcibly to my mind on reading "Re-echoes from the Oil Country," on page 439. I may as well confess myself guilty under all of Mr. Randol's criticisms, and also of a whole lot of other bad things that as yet he has not touched upon. If he would drop off here some day I would be glad to see him, and I could probably send him to a sanitarium by the shock that some of our practices would create. The only excuse I would have for any of them would be that they got there under *our conditions.*

From the interest Mr. Randol has evidently taken in the matter of some of my former bad jobs, I will offer a little explanation. The experiences narrated did not happen consecutively, neither did they all take place when I was foreman of the one little job shop; moreover, I did not make all the blunders at once.

I believe the bad jobs have done me some good, and I am still looking for ways of getting the largest efficiency from a given expenditure of force. When my eye first caught Mr. Randol's pencil sketch I looked at it as one of my own family group, the resemblance is so strong. On reading his article I am led to think that he has made some statements a little broader than he really means. When he says, "Retire the verbal order for good and all. No verbal order should be given or taken in a machine shop," I fancy he hardly means that the "no" shall always mean it—that is, *never* give *any* verbal order.

My way, though perhaps bringing some unexpected results occasionally, has been a trifle more elastic. When engaged in regular jobbing work I have always tried to hire men who have had experience in similar work, and I have usually given them credit for having a general knowledge of at least a few of the ordinary rudiments of the trade. Unfortunately, I was not there when the man Mr. Randol speaks of was put to work, although likely I would have expected him to be able to cut a thread without having to be put through a special course of instructions. I have had it hammered into me for some time that certain things about a job should always be put on paper, but there are details of finish and limits of accuracy and such points, that, where every job may be the first and last of its kind, require something to be left to the good sense of the workman, supplemented by *verbal* orders or instructions.

Our old friend Chordal once told us of a young man, fresh from college, going into the drawing room of a large establishment (Wm. Sellers, I think) and starting up the ladder of fame. He was told to make a drawing. When it was done and taken to the head draftsman he was asked if it was complete in every way, as it was to be sent away. The young man went away with it and by and by returned with numerous sheets of paper on which he had written such instructions as he deemed necessary to convey the ideas that the drawings needed. The foreman did not see the necessity for sixteen sheets of explanation for one sheet of drawing, while the young man evidently did not know there was any knowledge outside of his own kind.

It would seem as though a great deal of the best talent of the shop managers is at work trying to devise methods to make drawings and orders so plain and simple that misunderstandings will not happen. If any machinist, in any capacity, thinks he can get along without using his brains on his orders, whether written, verbal, drawings or samples, I fancy his voyage on the industrial waters will either be in a place where he is very low down, or he will serve under many commanders, who

will all be quite willing to pass him along. Some of the most valuable points I have ever received from the AMERICAN MACHINIST—and I am indebted to it for

FIG. 1. WELLS ON OIL CREEK WITH RECEIVING TANK.

many—have been along the line of how to dodge the mistake of too much system in one case and too little in another. I have not had a broad experience in the great shops of the country and have to take much of my knowledge second handed, but from a noted writer of recent date I get the statement that there is more of a tendency to go too far in trying to systematize than not to go far enough.

A man dislikes to lose dollars every once in a while by some blunder, but a steady, continuous stream of cents going out to make the other impossible may easily be the most expensive in the long run. There have been some systems that I have known of which looked likely to induce a stream of dollars going out without even a reasonable certainty of heading off the loss of the occasional cent also. I have no love for system for itself alone; I want it to pay its way just as that new lathe is expected to do or the man that runs it. The idea Mr. Randol advances of keeping orders is a good one, and records of a job often become of the highest value, although all jobs are not of enough importance to justify either a record or a sketch. A man competent to look after a job shop soon

FIG. 2. UP CORNPLANTER RUN.

learns nearly where to draw the line, and the only man I have heard of who got through a machine shop career without mistakes died before I got acquainted with him, although it is a very small shop indeed that cannot boast of at least one man who could run it in a great deal better way than it is being run and who isn't backward in letting his friends on the outside know it and incidentally letting them know also just how ignorant a boss he has.

I know that getting up a step often changes this man's views, and I don't think any capable man would ever make the mistake of trying to run any two shops in exactly the same way. Conditions are so different that to get the highest results they must be allowed for. Most men who have been in the business for any length of time can recollect seeing workmen get bossing jobs; men without much education, men unable to either write or spell well or to figure in fractions except as they had learned it from their scales, men who started to work so young that their school days were very few. Wonder has been expressed as to how they expected to hold such jobs with their limited education.

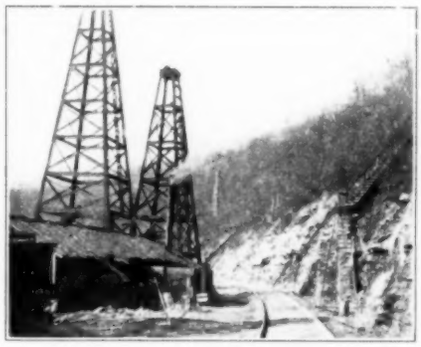


FIG. 3. WELLS ON OIL CREEK.

Listen to how outside men of the world speak of them. "He hasn't much book learning, but he is a *practical* man."

In a job shop the practical man will do turning with a side tool or a parting tool, do cutting off with a diamond point, do gear cutting with a hammer and chisel, cut threads with a file or any other atrocious thing if he knows it will do the job *good enough* and *quicker* and *cheaper* than any other combination at hand.

I very well recollect when a cub of making a small wrist pin for a valve stem, just a little affair with two collars, with a bearing about an inch long between them and an end outside of one about an inch long. A chunk of iron long enough to give room for a dog was center-punched in each end after having one end ground reasonably square. This was intended for the finished end. Wishing to avoid the loss of time due to changing tools, I took a parting tool and ran down where the shoulders would come. That left so little to come off that I did the rest of the turning with the parting tool, taking the finishing cut and finally cutting the pin from the main piece with the same tool. This was an after-supper job, and I had a visitor in the person of a young man who was putting in his time in one of the big shops near by. He had watched the job with evident interest, pity and amusement, and when it

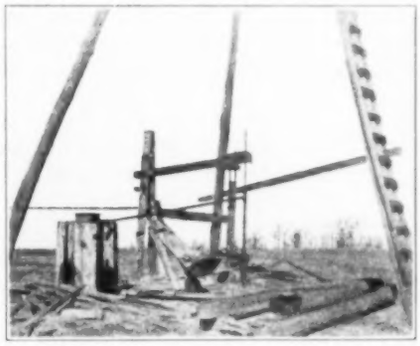


FIG. 4. A PUMPING JACK.

was finished he remarked: "Say, do they make you do all your turning here with a cutting-off tool? I have right and left side tools and turning tools for such jobs. I'd hate to have to use a tool that way, because you can never get anything just square with a cutting-off tool." He seemed surprised to find that that pin was square and plenty good enough, and more surprised to find that the boss never told me what tool to use unless I went to him for help to devise a way to do some unusual job.

Most men know which side their bread is buttered on and are more concerned about having it buttered than in splitting hairs about the exact system by which it is buttered. So that it's good butter and lots of it they are pretty well suited. Some shops apparently throw out the elaborate systems because it takes all the butter to lubricate the contrivances, and don't even leave oleomargarine for the stockholders.

I would be glad to take off my hat to Mr. John Peatie, whom Mr. Randol tells about. Such a man certainly belonged in a job shop, and I hope he will live long to enjoy himself and show others how to get there.

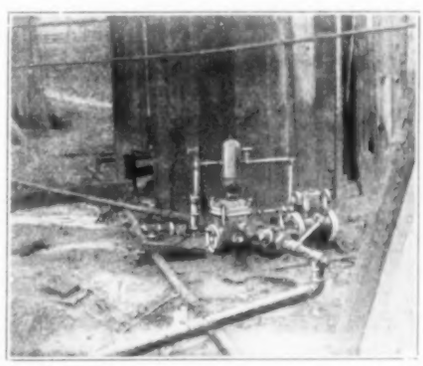


FIG. 5. OIL PUMP FOR PUMPING INTO RECEIVING LINE.

Doubtless the Oil Country is an unknown region to many, but to us who were born and raised in it there is only one Oil Country. There are other places where

oil is found, but to get the real fragrant oil, a whiff of which fresh from the well is as pleasant as the smell of roses in June (and hundreds and thousands of people in this country don't know the natural smell of our crude oil, so before they smile they should take a walk to the nearest tank and learn), and to get it you must come up among these Western Pennsylvania hills, and right at the birthplace of the industry you can find romance and tragedy and comedy beside which my "Echoes" will appear exceedingly quiet and commonplace.

To show that there is such a land, I send along as evidence some photographs that give an idea of the locality. I did think of sending my photograph also, but as the AMERICAN MACHINIST usually has an obituary along with a portrait of an individual I refrained from that, but hope most of you will understand that there is a man, and that he knows what machine grease is. I would like to send along a picture of the old shop, where it was so cold that a rat once came out and made an earnest plea to be allowed to go under the stove. Even after his plea had been very forcibly rejected he renewed it and so touched the hearts of his audience that he was allowed to do as he wished without further molestation. But the old shop and the rat, like the egg shells Tecumseh Swift writes so truly of, have served their purpose and passed away, along with much more that I can only transmit the echoes of.

W. OSBORNE.

From the Note Book of a Cosmopolitan—Draftsmen and Their Ways—Positive Feed Millers.

There are draftsmen *and* draftsmen. But this would hardly be discovered if judged by the opinions of draftsmen themselves. They seem to get settled down to a groove and there they appear to become a fixed quantity. Do draftsmen always know their value compared with those who work alongside them? Do they realize the widely different opinions with which their employers regard them? Do they understand how much they can increase their value by improving what they draw and *how they do it?* Are not many of them simply time expenders? How few of them really get through any great amount of work? And do they study methods of improving on the quantity of work that they do? Recently there appeared some correspondence in *Engineering* about the grievances of draftsmen and their salaries. Now, my opinion is that most of them are paid their full value. I know from experience in dealing with many of them that they work with very poor tools, and very few of them really know what is essential in a man who calls himself a draftsman and takes money for his services. Now to the point. A good draftsman should do good work, and do it rapidly! It has become a fashion to think that good work on a drawing-board can be done only by a proportionate expenditure of time. Nonsense! It is an idea grown rather from the fact that there is not the means of comparing the value of the work done. It resembles pattern-making where each piece of work is different, and no repetition. I believe that nine-tenths of the draftsmen working to-day can do far more work than they ever thought they were capable of, if they studied means of doing it. There are tricks in the handling of tools and set-squares and scales that are not a mystery and which any draftsman can acquire. I will perhaps some day go into this and have some photographs taken of the handling of tools, because word descriptions would not answer the purpose.

. . . . . .

A few engineers have acquired a reputation for making drawings rapidly. I believe that in Philadelphia it is still remembered with what rapidity the elder Mr. Bement could fill a sheet of paper with a design, and when it was done it was done. I remember years ago seeing some of these drawings and they showed that although everything "was there" no time had been spent in useless work. Mr. Richards (now in San Francisco) was also regarded as a wonder by those who had to do with his drawings when he was in Philadelphia. I have known a few in the West also, but after thirty years spent either on or near drafting boards I still maintain, although my language is perhaps too plain, that the average draftsman wants waking up. We are improving our shop methods, constantly trying to cut off a few cents here and there, waking up old methods, but what are draftsmen doing in this march of progress? Not much for many years.

. . . . . .

Many of your readers can remember when many machine shops made reputations and money when they had no draftsmen. Work was got out and sold and more made without elaborate systems. Perhaps this could not be done to-day, but this only argues that workmen and the times have changed. I remember going to work to make drawings in a shop where splendid machines had been made for years and which had been exhibited at foreign expositions receiving gold medals, and all without drawings, if you except bundles of sticks with lines scribed across them for the principal dimensions in the machines. To get out a set of drawings in the shop, a bundle of sticks all properly tied up and labeled were taken down off a rack. Certainly matters grew easier for the proprietor and the foremen after my arrival, but I never heard that they made more money after than before the event.

. . . . . .

A friend who has the pleasure of managing a machine shop is about to buy a milling machine, and asks my opinion on a subject which he says is not by any means settled in the minds of his foremen. Should the machine have a positive feed or in other words a feed driven direct by gears or one driven through a medium that can slip and give way when there is "trouble." His foreman reports to him that with the class of men and boys which he uses on millers there would be a "smash up" once in a while if his cutters and machines were provided with positive feed. He wants something that represents a breaking point, and thinks that a belt-driven or friction feed is better suited to the practical requirements of a milling machine. My friend states the case this way: There must be, in a well-designed miller, sufficient power to take the maximum cuts that the machine will stand and do good work, and he wants therefore to know "what more is wanted." My reply did not, I fear, help him very much. I called his attention to the fact that the two principal makers of milling machines, one of which is located in the East and the other West, and who ought to know all about it, are at loggerheads over this very question, and consequently where doctors agree to differ a layman like your humble servant had better "lay low" and say "nuffin." But, Mr. Editor, is not this just the kind of subjects that ought to be threshed out in your columns? One or the other must be on the right track. There may be some point about "positive feeds" for milling machines as understood in the West, but what has been happening to the poor non-positive machines for the past fifty years in the East? I presume they ought all to be "scrapped" right away, or how?

Probably Writes Illegibly.

"I haven't anything to say," remarked Henry Watterson of the *Louisville Courier-Journal* to a would-be interviewer who accosted him in the lobby of a Washington hotel, where he was recently staying. "When I have anything to say," went on the facile oracle of the Democratic party, "I write it, then I put it in my pocket. After a while I take it out, read it and write it again. Once more I put it away. Then I write it again and send it down to the printer and have it put in type. When I get the proof I run over it closely and write it again, and again it goes to the printer. Afterward it is sent to me again in the revised proof. Then I make the last corrections and send it down again. And then," continued Mr. Watterson, with a heavy sigh, "the confounded printer gets it wrong."

How Iron was Discovered.

Teacher—"Johnny, can you tell me how iron was first discovered?" Johnny—"Yes, sir." "Well! Just tell the class what your information is on that point." "I heard pa say yesterday that they smelt it."—*Montreal Star.*

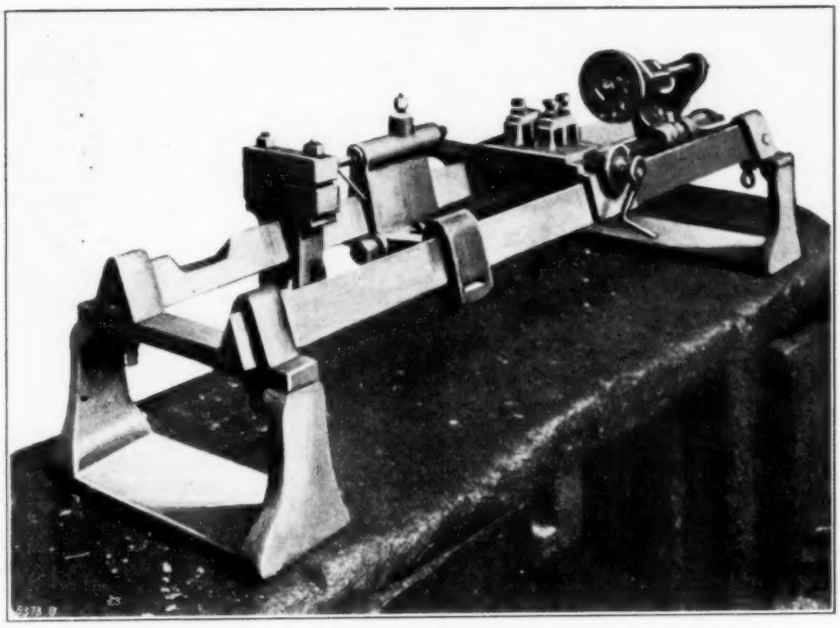


FIG. 1. THE ORIGINAL SCREW-CUTTING LATHE.

Some Early Machine Tools by Henry Maudslay.

The ancient engineering firm of Maudslay Sons & Field, of Lambeth, England, has disappeared, and at the closing of the works its equipment was sold. Although much of it was in use to the last, this equipment was very old, and some of it dated from the very beginning of the modern machine tool industry. Our London contemporary, *Engineering*, obtained photographs of some of these venerable relics and in connection therewith published a highly interesting article about them and the designer of most of them—Henry Maudslay. The accompanying illustrations have been reproduced from those given by our contemporary, and this article has been abstracted from the same source.

If any man is entitled to be considered the father of the machine tool industry and of accurate mechanical workmanship it is Henry Maudslay. Not only did he originate much that has long been standard, but through those who learned their

FIG. 2. BOLT-THREADING LATHE.

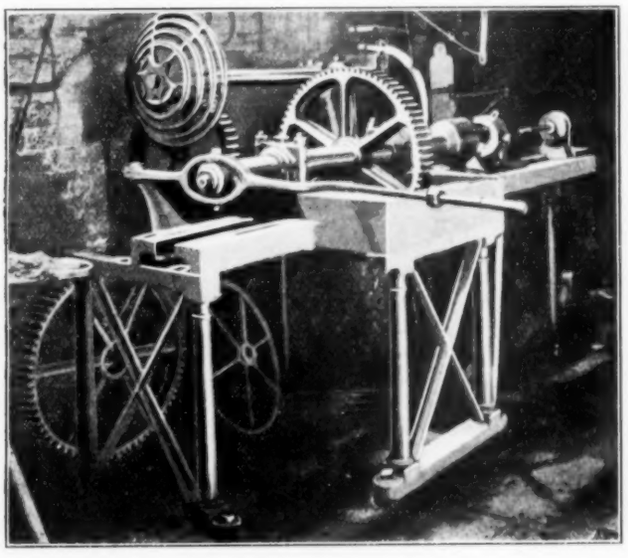


FIG. 3. NUT-TAPPING MACHINE.

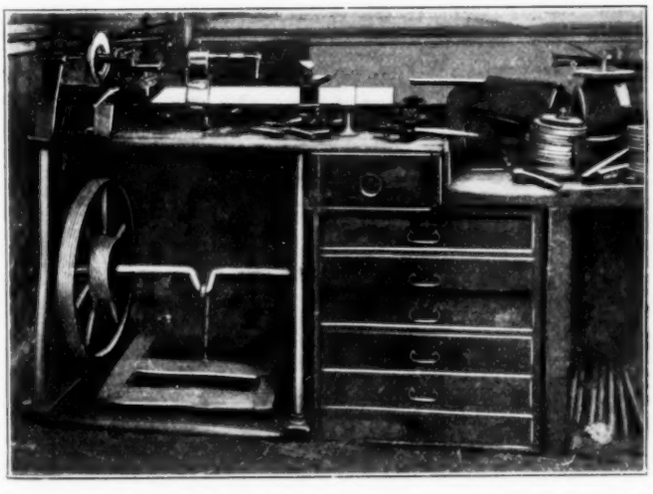


FIG. 4. FOOT LATHE FROM HENRY MAUDSLAY'S PRIVATE WORKSHOP.

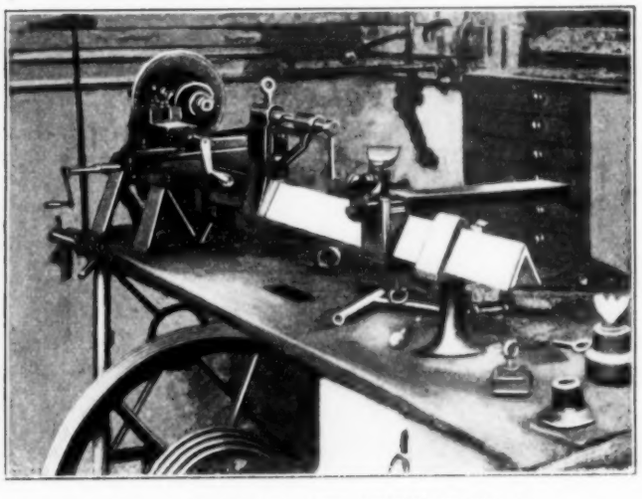


FIG. 5. DETAIL OF LATHE SHOWN IN FIG. 4.

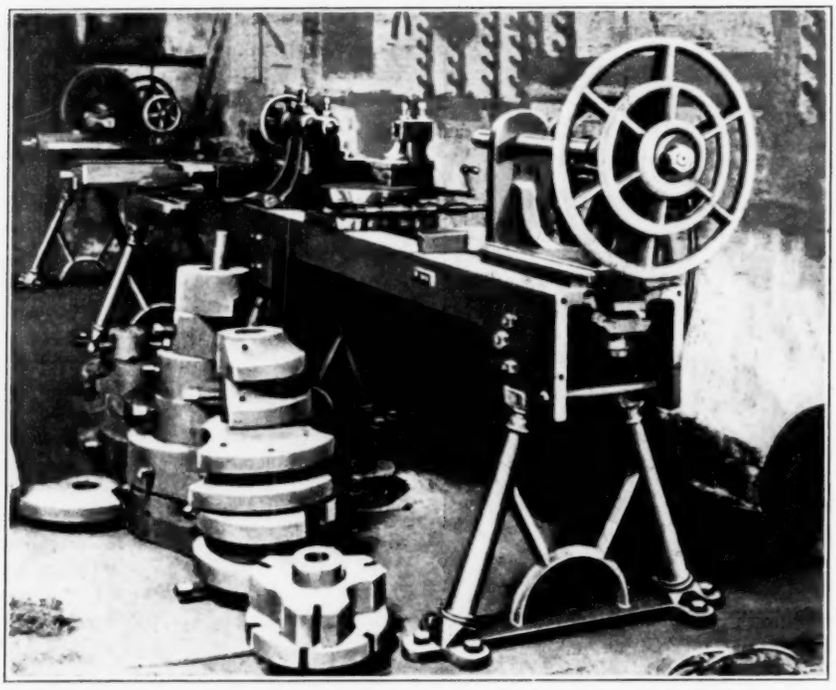


FIG. 6. LATHE WITH BALL-TURNING REST.

art from him his influence lived long after his death. Sir Joseph Whitworth served his apprenticeship with him and James Nasmyth was his pupil.

At the beginning of the last century there was no machine tool making industry. But few such tools were needed and those were of necessity invented and made by the user as the necessity arose. As each machinery manufacturer was the maker of his own machine tools, his achievements were largely determined by his ability as a machine tool designer and maker. It does not appear that the Maudslay firm was ever to any large degree a maker of machine tools for others. Its later fame, at least, was chiefly in connection with marine engineering, but the above considerations will explain why, in a historic sense, its fame must always remain with what, in a commercial sense, was not its product.

Prior to Maudslay's time the lathe was a hand lathe only. He invented the slide rest, which is equivalent to saying he originated the lathe as we know it, and accurate screws were first made by him. He was the first to grasp the magnitude of the perfect screw problem, and the production of such screws was, as Nasmyth testifies, his highest ambition. He contrived a machine for originating screws, and its product may be looked upon as the parent of all successors. He made the first screw-cutting lathe, of which the lead screw was made by this original process. This screw-cutting lathe (now preserved at the South Kensington Museum) is shown in Fig. 1, and a bolt-threading lathe is shown in Fig. 2, which, latter, however, appears to be of much later date, and from the architecture of its legs we should doubt if it is Maudslay's own. Combination gears were used on both these lathes to produce threads of various pitches. In Fig. 1 we see the original form of the V-top bed. Fig. 2, except for the buttress thread and the weight return to the carriage, has a strangely modern look, and, indeed, who shall say that the buttress thread is not better than the one commonly used for this purpose? Fig. 3 is a nut tapper, which is apparently Maudslay's own.

Maudslay's ideas of accuracy in screws went far beyond commercial requirements, as shown by the fact that he made a dividing engine for ruling circles for astronomical and other purposes, and the conception of accuracy in his mind may be judged from the fact that the graduations of these scales required a microscope to read them.

When we remember that previous to this time screws were made by hand chasers and at enormous cost, and that such things as standard screws were impossible, we must regard Maudslay's work in connection with screws as his chief achievement, and this whether we look at it from a commercial or a purely technical standpoint.

Figs. 4 and 5 show two views of a hand lathe which was Maudslay's personal tool. The headstock pulley will be seen to be drilled for use as an index plate. This pulley has four diameters, but the large pulley below has but one. To keep the belt tight on the different steps the crank shaft is arranged to be raised and lowered. Are we to assume from this that Maudslay did not know how to lay out a pair of cone pulleys of widely different sizes and with a short center distance?

Fig. 6 shows a lathe with a ball-turning rest, the action of which is obvious from the picture. The legs of this lathe are of a form which was characteristic of much of Maudslay's work. Another example is seen in the background of Fig. 6 and others appear in other illustrations.

Fig. 7 shows a large lathe, though by no means the largest made by Maudslay. It is a gap lathe with headstock and shears entirely distinct, the latter, like the example last noted, being of the "V" type. The rear bar of this frame is central with the live spindle and is the longer of the two, for the purpose apparently of supporting the tailstock. The other bar is so placed as to support the tool directly when doing large face-plate work. Fig. 8 shows the arrangement of driving gearing for this lathe. A three-step cone pulley appears on the spindle, which, as in many others of Maudslay's tools, was intended for a round belt. Beyond the cone pulley are three driving gears which, we are told, were driven from the large pulley at the left, though the method of connection is not very obvious. The face-plate is geared and

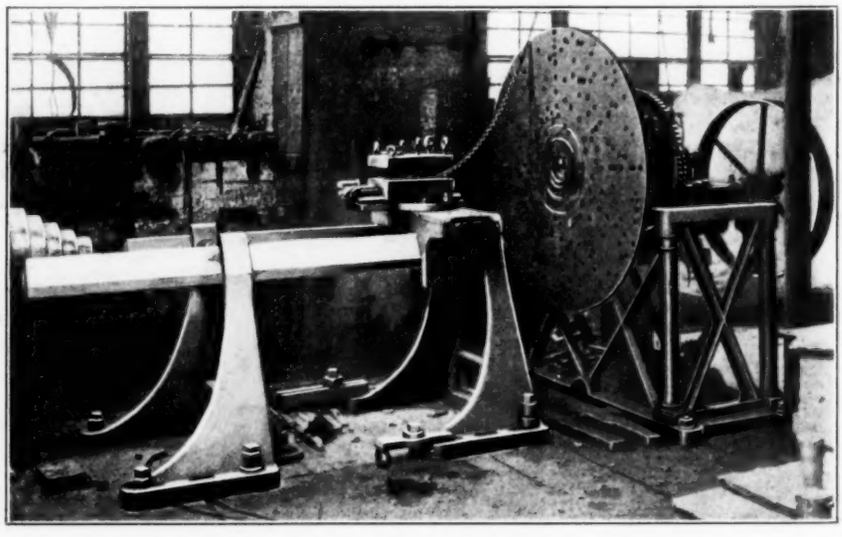


FIG. 7. HEAVY BAR LATHE.

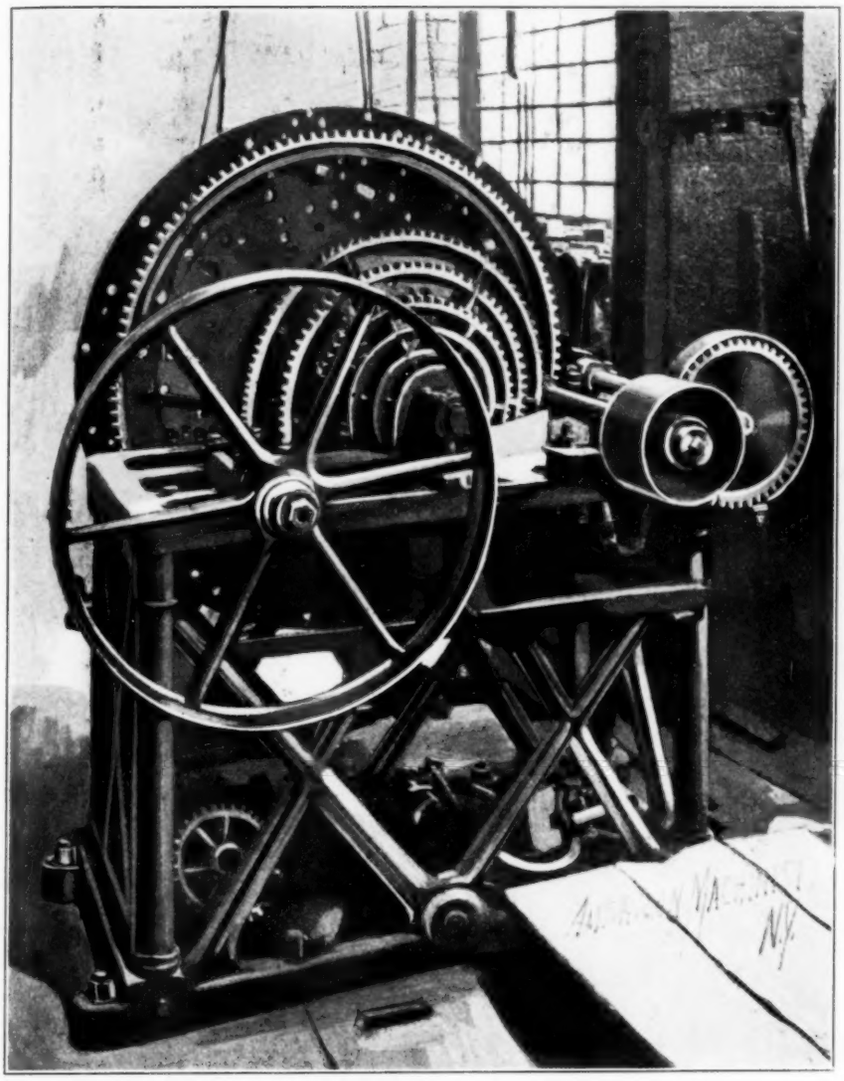


FIG. 8. GEARING OF LARGE BAR LATHE.

is driven by the small flat belt pulley and gears at the right.

Fig. 9 is obviously the progenitor of the modern horizontal spindle boring machine with elevating and traverse table, although the range of elevation is limited in the machine shown. Both table and headstock traverse crosswise of the bed, the latter movement being operative by hand or power and in our contemporary's opinion intended for milling.

Fig. 10 shows a very complete boring machine. Screws, miter gears, worm and hand wheel enable the bar to be adjusted vertically, while the feed is automatic and has several rates. The work table is adjustable laterally.

Fig. 11 shows the original shaping machine, or "steam arm," as it was called by Maudslay. The tool box slides on two cylindrical guide bars, which may be vertical in hight to suit the work. The work table traverses crosswise of the bed. Lying on the table is a revolving tool box, which reversed the tool at the end of each stroke in order that it might cut on both strokes. Fig. 12 is another shaping machine of decidedly modern appearance.

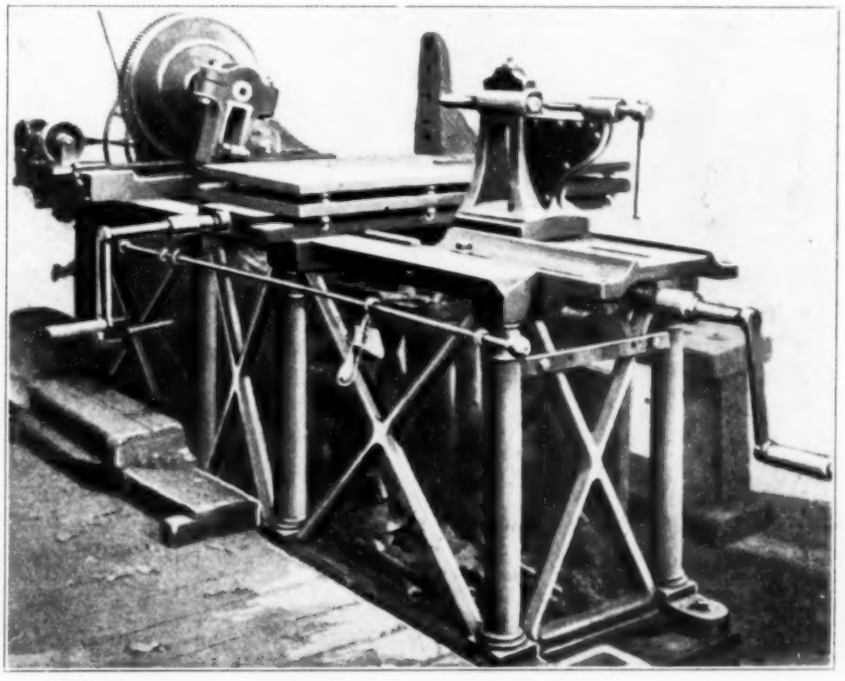


FIG. 9. BORING AND MILLING MACHINE WITH SELF-ACTING FEEDS.

Figs. 13 and 14 show two bevel gear cutting machines, the latter being decidedly modern in appearance. The headstock has a large index plate and the tool reciprocates on a bar which swivels about the apex of the pitch cone and is guided by a templet or former. The method of driving the tool is not apparent in either machine.

Fig. 15 is a portable shop crane, and is one of several made by Maudslay. Hinged counterbalance levers project from the rear which were, apparently, held down by the workmen when heavy weights were being handled.

The actual dates of most of these tools are wanting in our contemporary's description, but they are supposed to date from Maudslay's time and most of them are of his design. The most problematical in this respect, judging from their architecture, are Figs. 2, 12, 13 and 14, of which *Engineering* does not say in so many words that they are Maudslay's, and indeed it seems scarcely possible that they can be so old. Figs. 1, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 15 are undoubtedly his. The only actual date given is that for the crane shown in Fig. 15, which bears the date 1811. Maudslay began work on his own account in 1797, and the works which have just been dismantled were established on the site which they occupied to the last in 1810. The slide rest was invented before he established his own works and while he was working for Bramah, the famous lock maker. His first work on his own account was the screw-cutting lathe. Nasmyth entered his employment in 1820, his first work being on the machine for generating original screws, which was then several years old. Whatever may be their exact dates, which we presume are not known, there is no doubt that these illustrations

give us glimpses of the beginnings of things. Our contemporary, to whom the mechanical world is much indebted for putting an account of these tools on record, speaks in high praise of their workmanship as well as of their design, and many of them were in use to the last. Some of them, indeed—notably the bevel gear cutter of Fig. 14—were bought to be again set up and used. Most of them would seem to be more worthy of preservation as historical objects before which mechanics should have the opportunity of standing with uncovered heads.

Negative Slip.

A correspondent of *Engineering*, London, gives the following concise and interesting account of the phenomenon of negative slip:

Roughly speaking, about 80 per cent. of the energy of the screw thrust as actually applied to the ship is consumed in skin friction, and about 20 per cent. in throwing off waves at the bow; that is, providing that the speed of the ship in knots is not greater than the square root of the length of the ship in feet. The submerged portion of the hull of a ship is always wet, as one might say—the water is in optical contact with the ship. There is no film of gas or air between. It therefore follows that that film of water which actually touches the ship is practically traveling at the same velocity as the ship, and perhaps ⅛ inch outside of this we have water traveling at three-quarters the speed of the ship; while at a distance of ½ inch the water may be traveling at half the speed of the ship. No matter by what means the ship is drawn or pushed through the water, if 80 per cent. of the energy ex-

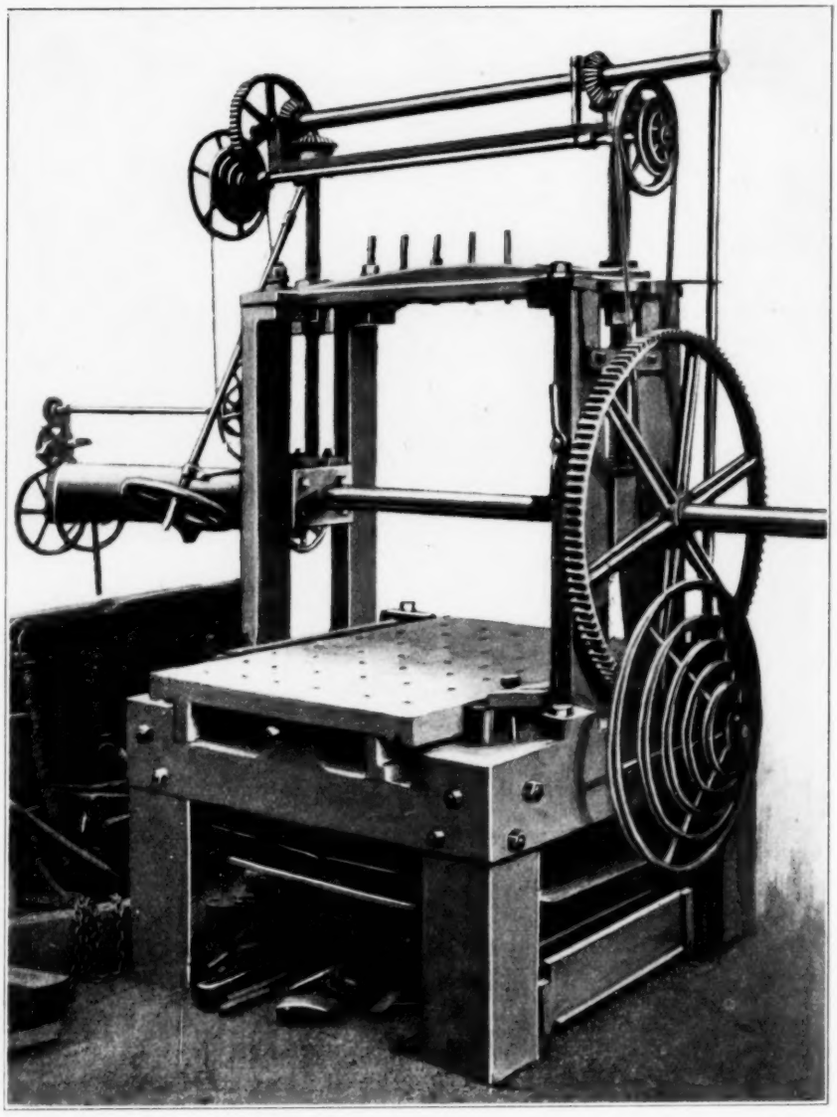


FIG. 10. BORING MACHINE.

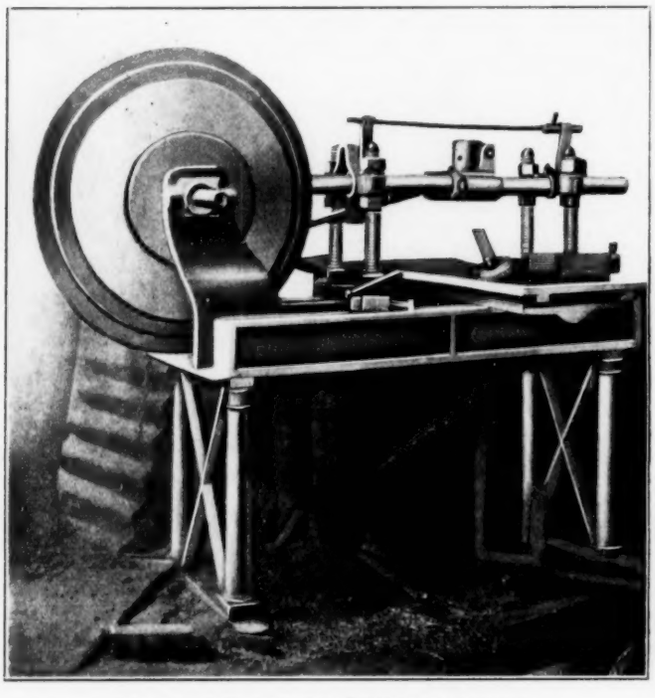


FIG. 11. THE ORIGINAL SHAPING MACHINE.

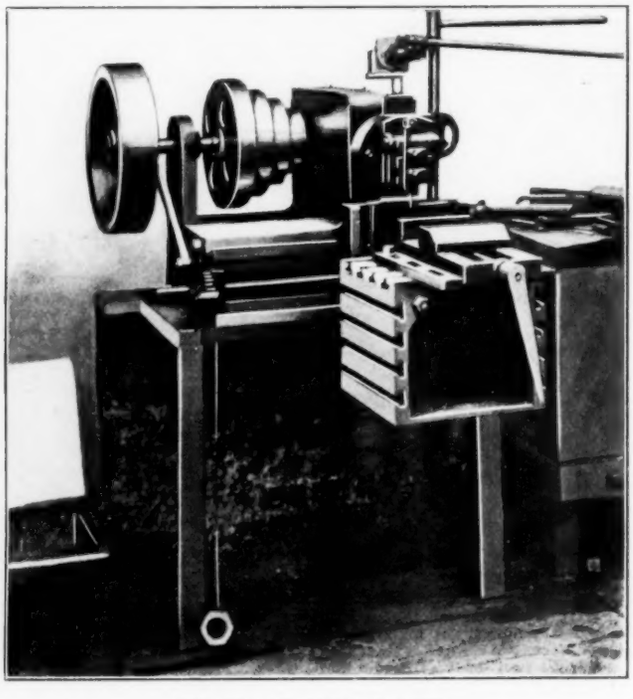


FIG. 12. AN EARLY SHAPER.

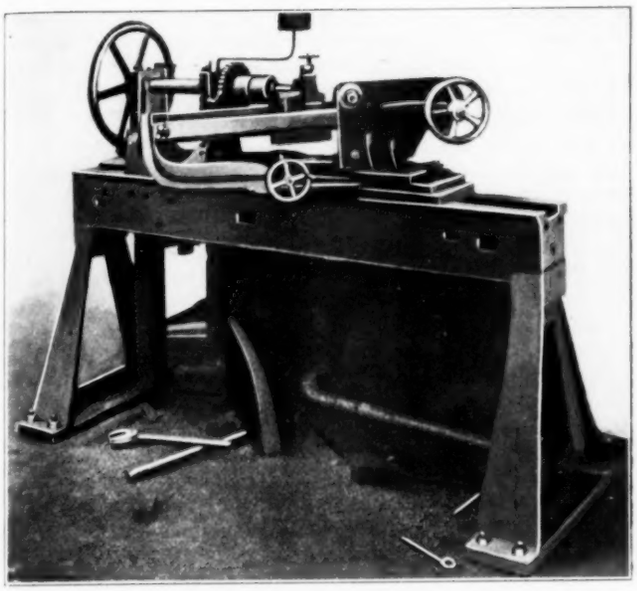


FIG. 13. AN EARLY BEVEL-GEAR CUTTER.

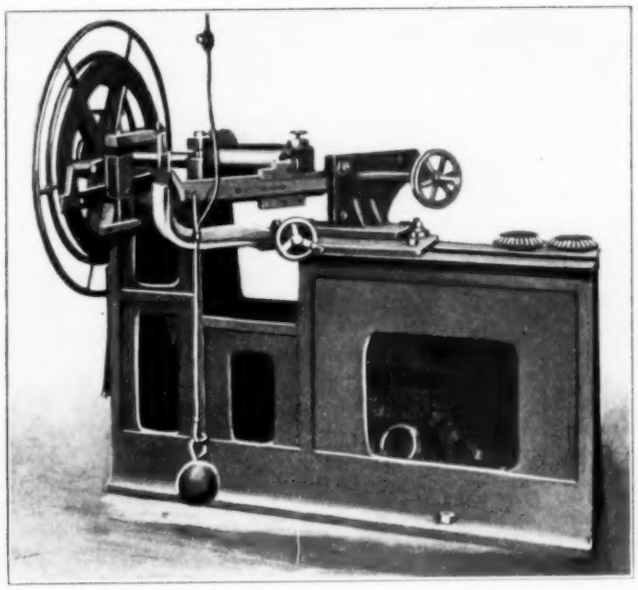


FIG. 14. BEVEL-GEAR SHAPER WITH TEMPLET AND LARGE DIVIDING WHEEL.

pended is communicated to the water through which the ship is passing, it will be found that the water just aft the ship is traveling in the same direction as the ship, but not at so great a speed. Suppose that the ship has a speed of 16 knots, and that the water just aft the ship is following the ship at the rate of six miles an hour, and the screw has a positive slip in this water of only 5½ miles an hour; under these conditions the screw will actually appear to have a negative slip of half a mile an hour. It has often been said by engineers that the efficiency of a screw propeller is beyond all reason; and this might be quite true if the screw were running in water which had not been set in motion by the ship; but it is quite within reason when one takes into consideration that the screw is working in water which in reality is traveling in the same direction as the ship at a considerable velocity. The facts are as follows: The greater part of the energy expended by the screw in driving the ship through the water is communicated to the surrounding water and sets this water in motion, and as the screw is worked in this water a certain amount of energy is recovered, and this accounts for the extraordinary efficiency of screw propellers, and also for the very rare phenomenon of negative slip. I think it is a fact, however, that negative slip shows some fault in the construction of the hull, and that the hulls of all vessels having negative slip have an abnormally high coefficient. But this whole subject has been thoroughly thrashed out before. It was in the year 1867-8, I believe, that a ship, the *Bellerophon*, was built for Her Majesty's Government, which sailed faster than she would have done if the screw had been running in a solid nut. This ship was tried over and over again, and there is no question about it; the screw did have a negative slip, and this was a subject for discussion in the scientific papers in both England and the United States, which extended over two or three years. I remember this distinctly, because I was a draftsman in a large steamship-building place at the time.

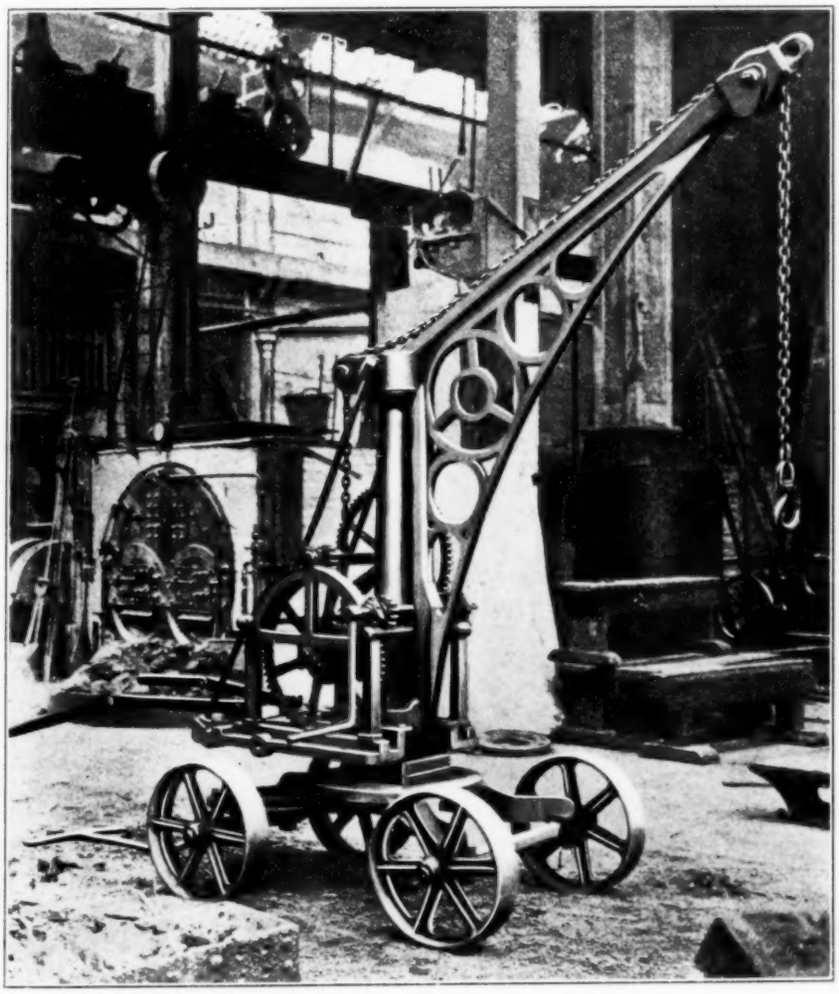


FIG. 15. SHOP CRANE, DATED 1811.

We have received a pamphlet containing an illustration, with brief description, of the new manufacturing plant of the Wellman-Seaver Engineering Company, Cleveland, Ohio.

Fans and Piping for Forges.

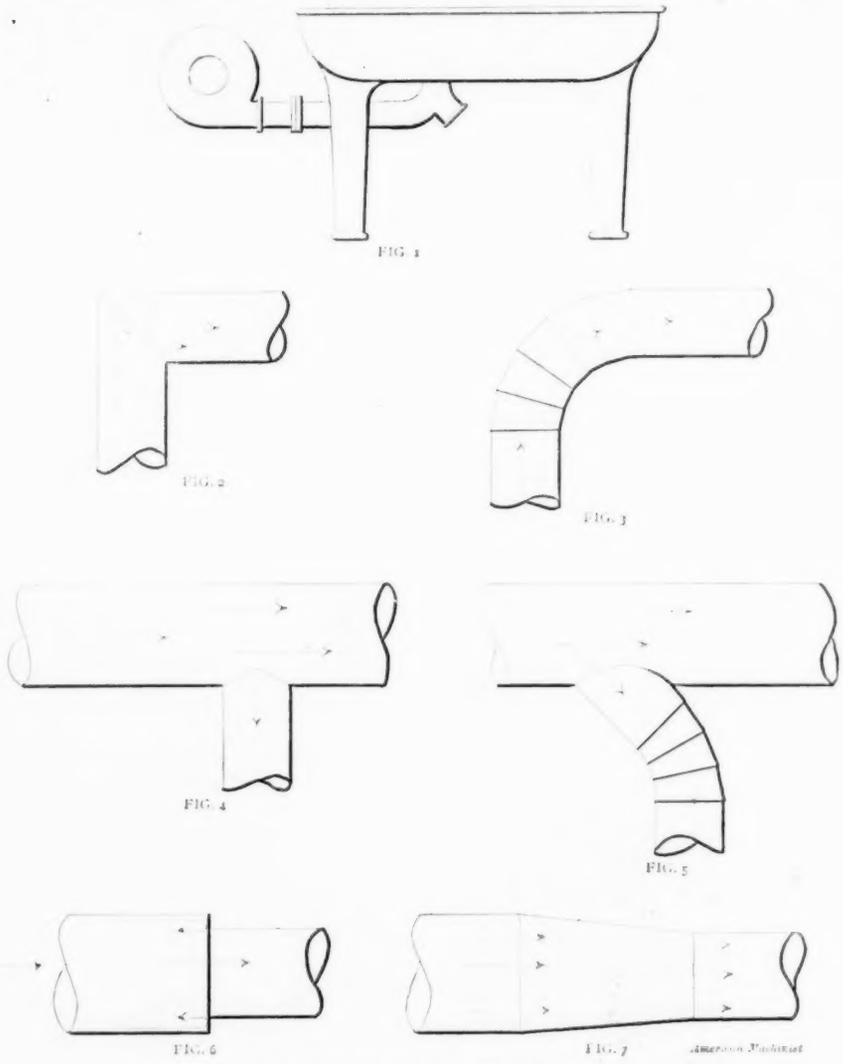
BY WM. SANGSTER.

The fan or centrifugal type of blower is the one generally installed for furnishing the air blast to forges, since the power required to drive the same varies with the number of forges in use—that is, the power consumed by the fan increases as the forges are turned on and decreases as they are turned off. Some suggestions as to the approximate costs of blowers and piping as well as a few hints on arranging the same may be of interest to the users of forges and blowers.

BLOWERS.

Selection: There are in use two types of fan blowers known as the "pressure" and "volume," respectively. The former or pressure fan is designed to deliver air under a pressure up to 16 ounces per square inch, and is used principally for cupola work or for forge work requiring a strong blast. It is a narrow type of fan and delivers a comparatively small quantity of air. The wheel should be closely fitted to the sides of the fan so as to prevent undue leakage.

The "volume" or wide fan is designed for pressures up to 6 or 8 ounces and delivers a larger quantity of air. It does not require so much care in fitting the wheel since the percentage of leakage is a minor factor in its efficiency. It will take care of a greater number of fires than the narrow fan, with a wheel of the same diameter, and is therefore cheaper in first cost. It may be used to advantage in forge work requiring an ordinary pressure of blast. The points to be looked for in a blower are well balanced wheels, rigid shafts, generous bearing surfaces and ample lubrication. The difference between the price of a well-made fan as furnished by a reliable manufacturer and that of a cheaper and cruder make is so small that the difference in repairs and annoyance will more than repay the extra outlay in a year's run.



ARRANGEMENT OF BLAST PIPES FOR FORGES.

Costs.—The following lists of forges and prices of fans to supply the same have been taken from the catalogs of leading manufacturers. A discount is given from these regular catalog prices, but when to the cost of the fan at the works is added the freight and teaming charge, as well as the cost of erection, it will be found that the prices given are not excessive. In the Far West from 15 to 20 per cent. should be added on account of the increased transportation charges:

Pressure Fans. Number of Forges.	Price.	Volume Fans. Number of Forges.	Price.
1	$12.00	1	$12.00
2	15.00	3	15.00
3	20.00	4	20.00
4	26.00	7	25.00
5	36.00	9	33.00
7	44.00	13	44.00
9	55.00	21	55.00
12	70.00	25	70.00
16	90.00	40	90.00
22	115.00	58	150.00
35	170.00	85	200.00
50	225.00	135	250.00
60	300.00	200	325.00
90	400.00	230	350.00

The ordinary pressures for forge work range from 2 to 4 ounces and average about 2½ to 3 ounces. The proper speed for any particular fan may usually be found in the manufacturers' catalog; but, if one is not handy, an approximation may be found by dividing 10,000 by the diameter of the fan pulley in inches. These results will be sufficiently accurate for average work.

The horse-power to be allowed for a forge shop is a hard matter to determine since there are so many conditions involved in the problem. The length and sizes of blast pipes, arrangement and number of elbows, branches, etc., all have a bearing on this question. A fairly safe rule, and one that will provide an ample margin, is to allow ⅕ to ¼ horse-power for each ordinary forge, adding 1 to the number of forges; for example, the fan for a 20-forge plant will require from 4⅕ to 5¼ horse-power.

One of the usual errors made by fan users is to buy a blower with an insufficient capacity. It is such a simple matter to overload a fan, or, in other words, to run it at a higher pressure than is actually required for the work, that the loss of power is overlooked and an ordinary sized fan may waste its first cost in a year's time. This waste of power is more apt to occur when additional forges are installed and the fan has to be speeded up to deliver sufficient blast. Now, while the air delivered by a fan increases almost directly with the speed, the pressure increases as the square and the horse-power required as the cube of the speed; that is, if we double the speed of a fan, we will obtain nearly twice the air at four times the pressure and with an expenditure of eight times the power. For example, suppose a fan carrying twenty forges cost $55.00 and it is proposed to add five more forges, making twenty-five in all, the power required by the old outfit will average about 4½ horse-power and by a new and properly proportioned fan about 5¾ horse-power.

To obtain sufficient air by the old fan

we should have to increase the speed 25 per cent., and the power required would be 5-4 × 5-4 × 5-4 × 9-2 equals 8¾, approximately. A fan of the proper capacity would require about 5¾, which means a saving of 3 horse-power, equivalent to $75, or more, per year, or about the price of a new blower.

BLAST PIPING.

After selecting a blower comes the question of setting it up. As a rule, it should be placed as near the forges as possible, and yet away from the dust. The ideal blast system, as regards saving of friction, etc., would be similar to Fig. 1, where the blower is connected directly to the forge, but this is usually out of the question. We must remember, however, that the purpose of a fan is to create blast at the fire itself, therefore the piping should be large and well soldered. Bends and branches where necessary should have long, easy curves, and in fact the entire system should be laid out on the principle of a fire hose and its nozzle. We understand the benefit of a large hose allowing a slow velocity of water to the nozzle, and should lay out a blast system on the same lines.

An elbow such as shown in Fig. 2 creates eddy currents which check the flow of air in a similar way to an obstruction in the pipe. The curved elbow shown in Fig. 3 gradually changes the direction of the flow and avoids loss by eddy currents, etc. The inner radius of the elbow should never be less than the diameter of the pipe itself. Branches when taken off a main should not be cut in square as per Fig. 4, since if there is sufficient velocity passing the outlet there will be a flow inward instead of outward—that is, the air passing the opening may act as an injector. All branches should be arranged as shown in Fig. 5, with an angle not greater than 45 degrees and an elbow of long, easy radius to complete the change of direction.

In changing from one size to another, the reduction should not be made as per Fig. 6, since the square end has a tendency to cause eddy currents similar to the case of an elbow. A conical reducer from 20 to 30 inches long, shown in Fig. 7, should be used for this purpose.

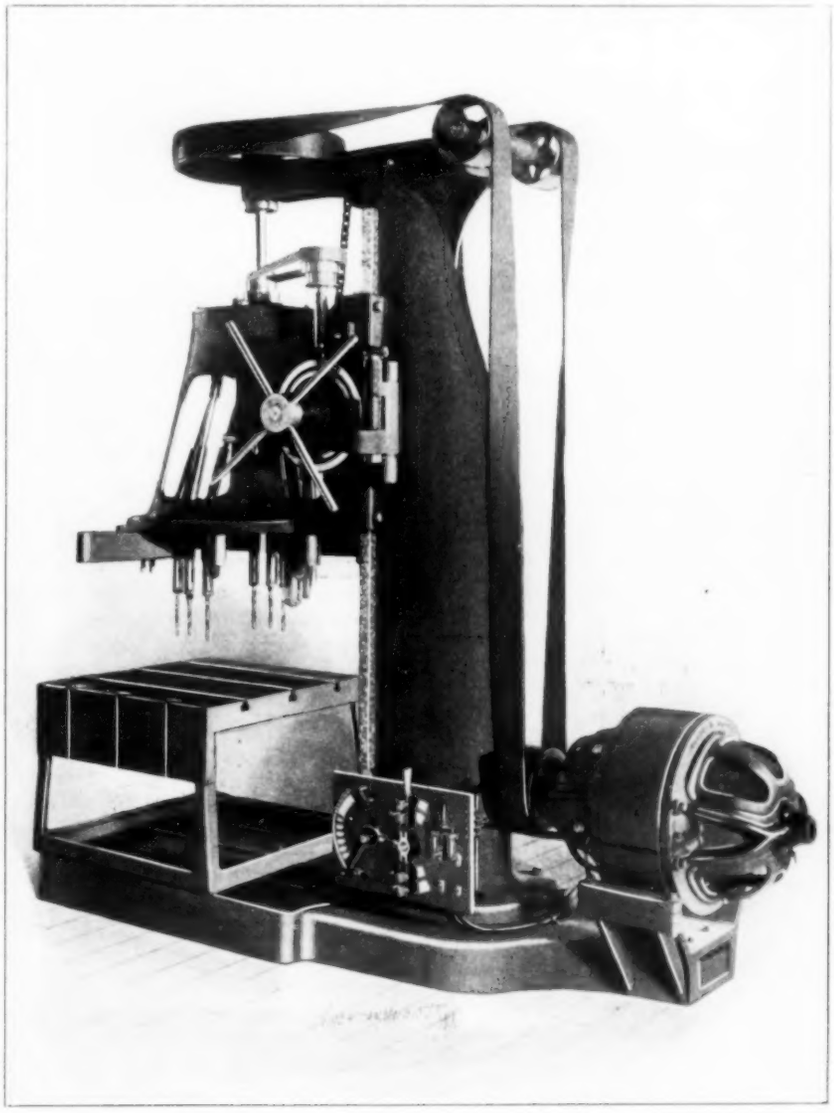
These suggestions are of course very simple, but one need only look at the average blast system to realize the lack of appreciation of what constitutes a good or bad arrangement of piping. When a system is put up by a local tinsmith or sheet iron man the points enumerated above should be especially insisted upon. Such local men do not, as a rule, have sufficient experience to realize the losses that exist through a defective system of piping. Very often a blower is condemned for lack of blast when the fault lies in the piping itself.

The question of cost of piping for a forge outfit varies with different localities. A rough estimate would be to allow 5 or 6 cents per foot of pipe for each inch of diameter. Elbows and branches cost approximately as much as 6 to 10 feet of pipe. These are of course rough figures, and the actual cost may run a little below or above these averages.

Most of the modern cast-iron forges are fitted with gates to control the blast; but for places where these have not been provided, the cast-iron gate with closely fitted steel slide is best adapted for the purpose. The usual sizes range from 2 to 4 inches, and the costs are: 2 inches, $1.25; 2½ inches, $1.50; 3 inches, $1.75; 3½ inches, $2.50; 4 inches, $2.25. These prices are subject to discount, but the express or freight charges will bring them very nearly up to list. In the far West these prices may range from 15 to 20 per cent. higher, as in the case of the blowers.

Variable Speed Electric Motor with Two Armature Windings.

We illustrate herewith a multiple speed drilling machine fitted with a variable-speed motor of a very unusual range of speeds, which are obtained by the use of two sets of armature windings in combination with two commutators and field resistances. The windings may be operated independently or combined. Independently they give different speeds and combined a third speed. The gap between these speeds is such as to be covered by the range obtained by the field resistance, the field resistance range being thus available on top of each armature speed, so to speak. The extreme range of motor speeds is from 465 to 1,620 revolutions per minute, there being in the motor shown no less than twenty speeds within this range. In the case of the machine shown this gives a range of drill spindle speeds from 68 to 244, there being thus an average variation of less than seven per cent. between the various successive speeds with a range of over 3½ to 1 between the highest and lowest. As is well known, the use of field resistance does not reduce the efficiency of the motor or its constancy of speed under variable load. The motor is made by the Commercial Electric Company, of Indianapolis, Ind.



MULTIPLE SPINDLE DRILL WITH VARIABLE SPEED MOTOR.

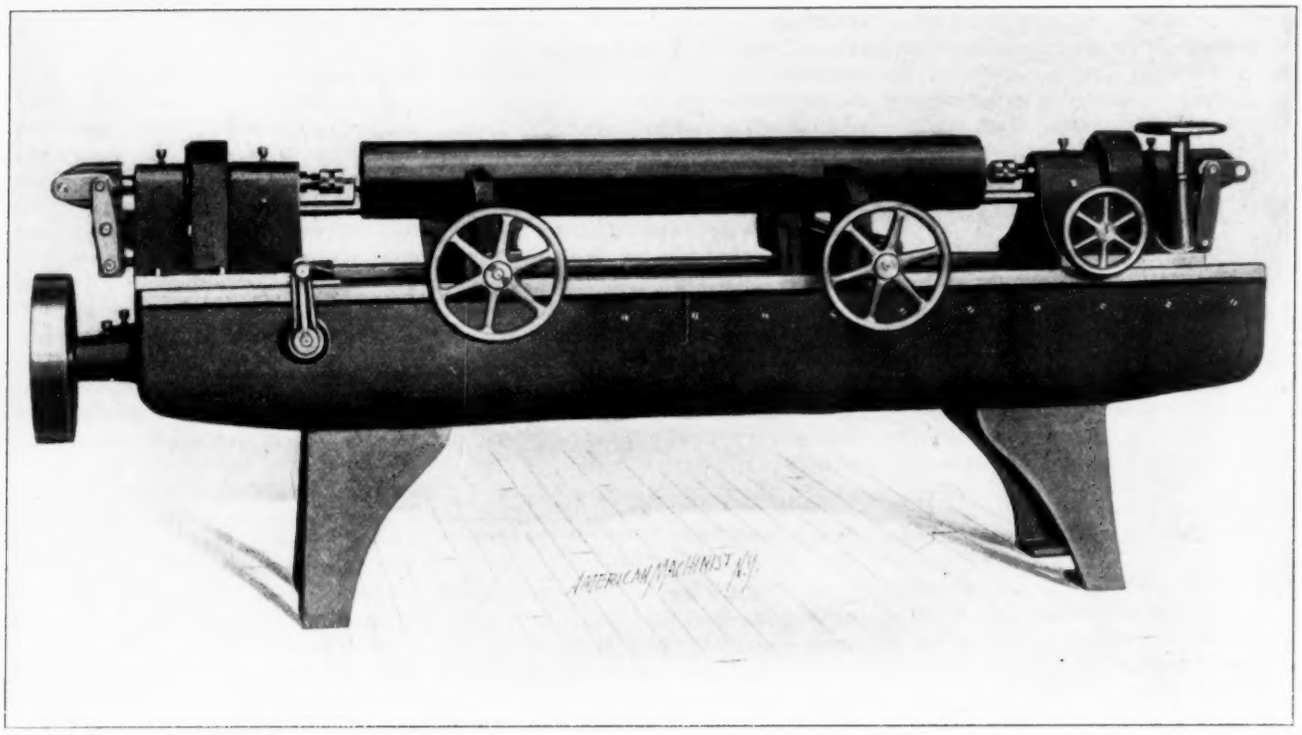


FIG. 1. DUPLEX AUTOMATIC CENTERING MACHINE.

Duplex Automatic Centering Machine.

The acompanying half-tone and line engravings illustrate a new centering machine which is the product of the Railroad Supply Company, Bedford Building, Chicago. The machine is intended to drill and countersink both ends of a bar at one operation and has a wide range in both the diameter and length of stock which it will accommodate.

Fig. 1 gives an excellent general idea of the machine, a piece of stock being shown in position. Two chucks center the work and two live heads drill and countersink the centers. One of these heads is fixed on the bed, while the other is adjustable to suit the length of the work, the adjustment being quickly made and saving time in the centering of even a single piece of heavy stock as the head can be adjusted more quickly than such a bar can be reversed in position. Each head is fitted with an adjustable stop finger which protects the center drill while the bar of stock is being placed in the machine, and also acts as a gage for locating the work and automatically insuring correct and uniform depth of center.

When the work has been inserted the vertical lever at the left-hand end of the

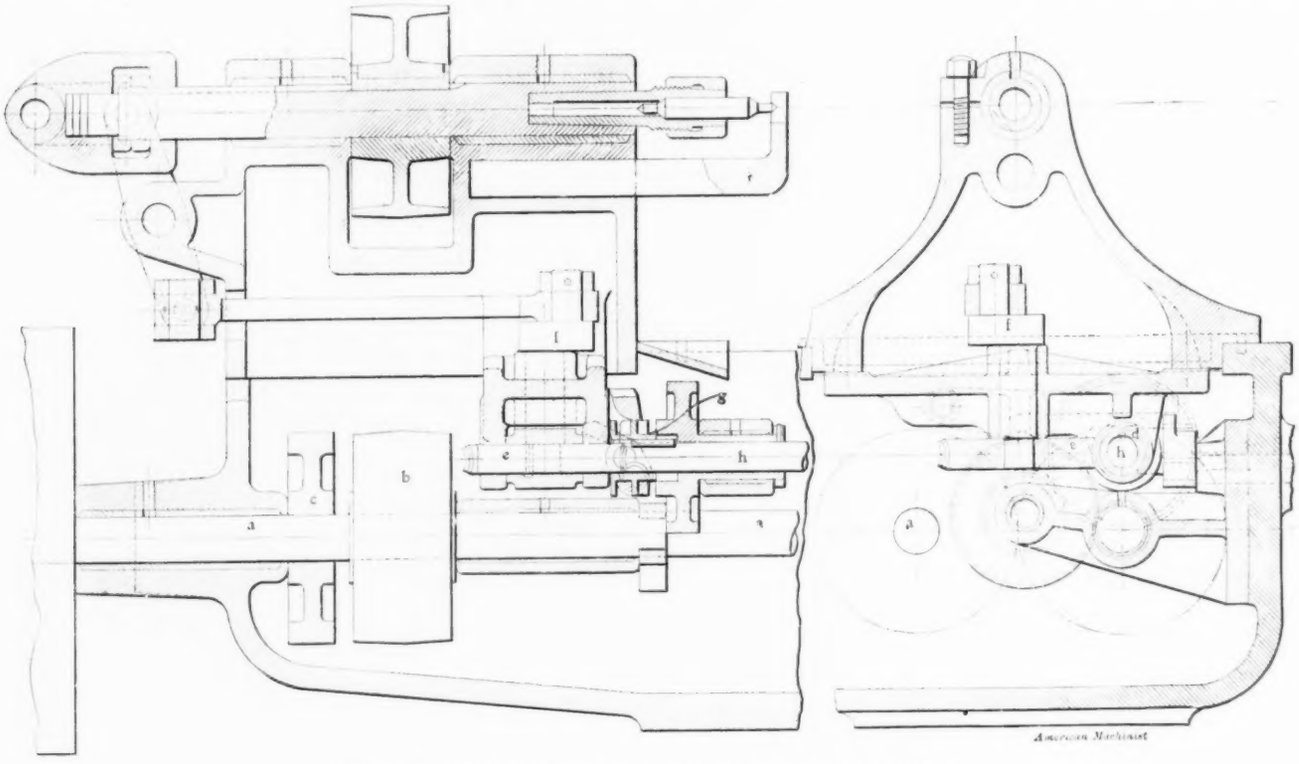


FIG. 2. HEADSTOCK OF DUPLEX AUTOMATIC CENTERING MACHINE.

machine is operated, when the drills advance, drill and countersink the centers, retire and then stop until another piece is inserted and the handle is again operated.

The mechanism by which these movements are accomplished is shown in Fig. 2. The driving shaft *a* is driven by the pulley at the left and runs the entire length of the machine. Pulley *b*, which is fast on the shaft *a*, and a similar pulley, below the movable headstock but splined to the shaft so as to move with the headstock, are belted to pulleys above them on the drill spindles, which by suitable chucks drive combined drills and countersinks of suitable size for the work. Gear *c* and a train of gears shown in the cross-section drive worm *d* and worm wheel *e*, on the upper end of whose shaft is a crank *f* which, by the links and levers shown, advances and withdraws the drill spindle. Worm wheel *e* has upon its upper side a lug which operates a claw clutch *g* to disengage it, this clutch serving to drive the worm *d* and being engaged by the vertical hand lever shown at the left-hand end of Fig. 1. This lever when operated starts the feed gear in motion, which advances and withdraws the drill when, the worm wheel *e* having completed a revolution, its lug disengages the clutch *g* and the feed motion stops. The action is the same at the other end of the machine except that as the two worms are driven by one long shaft *h* the lug on the left-hand worm wheel disengages and stops both feeds. The hand wheels on the right hand headstock are for traversing and clamping it on the bed. One of the gage stops for gaging the depth of the center and protecting the drills from damage is shown at *i*.

Fig. 3 shows the centering chuck which rests on the bed at *j*. It has three jaws *k l m*, which are arranged at 90 degrees with one another. Jaw *m* is operated by the bevel gears and screw shown and serves to center the work vertically without gripping it. The gripping is done by the jaws *k l*, which are operated by a right and left hand screw. It will be observed that this arrangement of jaws permits the work to be removed after a very slight releasing movement of the hand wheel.

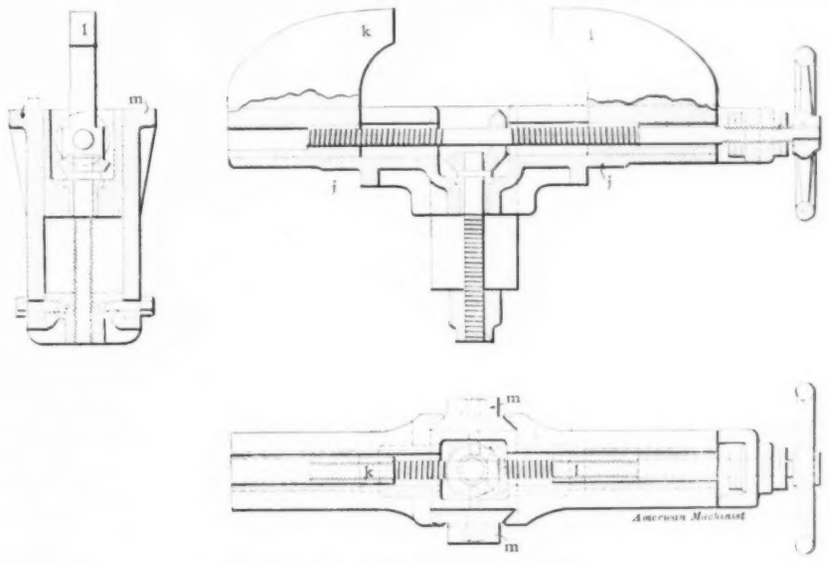


FIG. 3. CHUCK OF CENTERING MACHINE.

Process of Hardening Copper.

A United States patent has recently been granted to Carrie Renstrom, of Seattle, Wash., for a process of hardening copper. No definite information is given as to the actual hardness attained. The description of the process is as follows:

"In treating copper or the alloys of copper by my hardening process I find it preferable to use alloys of copper. I have experimented successfully with different alloys, but find that an alloy of copper and tin gives exceedingly fine results when treated by my process. Different alloys of copper will be employed, according to the use to which the alloy when manufactured into the desired product will be put. It is usual to cast or shape the copper or the alloy of copper into the particular product—as, for instance, a trolley wheel, journal bearing, propeller wheel, or tool—before the same is hardened. The castings are heated over a fire, preferably of charcoal, for a suitable length of time—say about three minutes—and with a proper amount of heat. I have found that when the heat has reached a point at which tin will melt it gives the best results. The castings of copper or alloys of copper are preferably laid on the charcoal bed or fire. The castings, and incidentally the charcoal, are sprinkled with sulphur, preferably in a pulverized condition, so that the castings will be coated or covered with the sulphur, and the fumes of the sulphur will also come in contact with the castings. The sulphur is preferably applied after the castings have been in the furnace until they have become thoroughly heated. After the sulphur has been applied, the castings are permitted to remain in the furnace a short time. They are then removed from the furnace and while still hot are dipped in a solution of blue vitriol and allowed to remain for a short time. After the castings have been subjected to the blue vitriol bath they are preferably reheated and then allowed to cool without the application of any cooling agent.

I have made actual tests with the above process upon copper and the different alloys of copper and have found that the same have become hardened to a remarkable degree without destroying the ductility of the metal, and that for commercial purposes the thus hardened copper or alloys of copper are very useful where hardness and at the same time ductility and toughness are required.

The Inventor's Modern Way.

"I am writing a story of a struggling inventor."

"It won't do," answered the abruptly critical friend. "Inventors don't struggle nowadays. They let the people who are eager to buy stocks do the struggling."—*Washington Star.*

Professor Exner, of Vienna, in a recent lecture spoke of technical experts and of the propriety of more generally employing or consulting them in connection with the framing of laws and the administration of them. He spoke of the technical experts of the world as numbering at least 5,000,000 in the various grades, pleaded for the creation of politically independent technical departments and urged the technical experts of Austria and the rest of the world to combine and secure greater influence and self-importance. The advice applies to the United States both in National and State affairs. Our neglect of expert advice in the preparation of bills relating to technical matters—and a large proportion of all new legislation has to do directly or indirectly with the technical—is a costly mistake and retards our progress in many directions. As it is, the technical expert is now more apt to be called to explain the causes of the inevitable conflicts and disasters rather than to point them out in advance and show the ways to avoid them.

Gilding on steel is imitated by galvanically coating with copper from a cyanide bath, then with a thin film of zinc. After drying and polishing the article is heated in linseed oil to 160 degrees Cent., when it is stated that the surface becomes of a red brass color, as if there had been a real alloying of the copper and the zinc.—*Horseless Age.*

Fielden's Magazine (militantly British) chronicles as though it were important the fact that an English house has secured a contract for flour-mill machinery to go to China in competition with American builders.

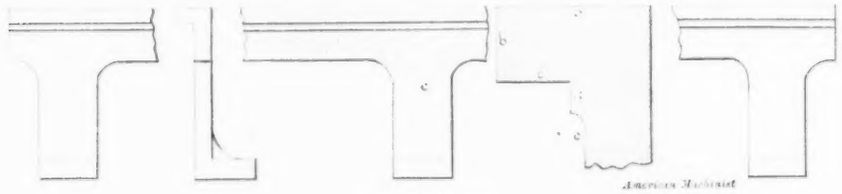
Letters From Practical Men.

The Limitations of Peening.

Editor American Machinist:

When I read the "Echoes from the Oil Country"—and I always read them, and usually before I read anything else in the paper—I am sometimes gripped with sore pangs of jealousy, because it is so evident that Osborne is favored by opportunity more than the rest of us. The Oil Country people and the Oil Country materials often act differently from the ways I have been used to, and some of the things that happen to him are peculiar. If they were not, I suppose they would not be so worth the telling and the reading.

Now about peening, which is his latest story, I am compelled to say that Mr. Osborne has found a combination of more ignorant mechanics and more compliant material than I ever struck. I suppose I could have found isolated individuals around shops and mills to whom the peening operation would be a novelty, but never whole gangs of men and never any old shop proprietor. I have assisted at the straightening of warped cast-iron frames by peening as Mr. Osborne describes, but I never saw the time when I could straighten a 4⅜-inch crank shaft by "nice little marks," and a wabbling crank disk I would never have tried to bring true by peening.



A PEENING JOB.

If there is anything about the shop that I know something about it's peening. Look at the sketch. When I was fifteen or sixteen years old I was planing hundreds of those sawmill slides. They were about 6 feet long, with three legs, and they were planed at *a*, *b*, *c* and *d* all at one setting, the tongue *a b c* being about ⅝ inch square and the side *b* being the top as it lay on the planer. It is not worth while to say anything about the planing, as there was nothing very difficult or unusual about the job when properly set and fastened. The part that did call for skill and judgment was in the straightening of the castings by peening them before the planing. The castings as they came from the foundry were concave about ⅜ inch on the side or face *b* and about ⅛ inch on the top *a*. There was a rather remarkable uniformity in the way they were sprung, and of course there are many readers of the AMERICAN MACHINIST who can now suggest that the pattern could have been easily sprung enough to correct this, but no one then thought of it, and in those days they were not in the habit of thinking as far as that. Well, I had to straighten every one of these slides before planing. This was done by peening on the tongue at *b* and on the flat part at *c*. It required a good many hammer dents on the flat part and more and heavier ones on the tongue at *b*. There were not many "nice little marks," but good, heavy pounding. The metal in the tongue was of course required to be stretched considerably more than that of the plate, and the stretching of the metal had to extend well down into the body of the tongue. The effect of the blows had to be such that much of that effect would extend deeper than the planing, or otherwise the slide would spring back again after the outside was planed off. It was the same about the peening at *a* to correct the concavity on that side. The hammering had to be heavy enough to stretch the metal there, too, deeper than the planing. Well, I got so that I could do that job so that the slides would be practically straight every time after they were taken off the planer, and to do that I had to know quite a little about peening, and I learned more in after years.

About that planing job I have one touching recollection. As I have said, I was about fifteen, and I was not a big overgrown chap, for up to the age of thirty I never weighed more than 120 pounds. These slides, before I was put at the job, had been done by a full grown, large-sized, experienced, all-around journeyman machinist at five times the wages I was getting. Handling them was for him only play, while I was unable to lift the whole slide on to the planer. I had to get one end on first and then lift the other end on. In peening I don't suppose I could strike a harder blow than the other man either. Well, I had been at the job for some time and was getting along all right with it and was feeling pretty good over it, when one day the boss came along and he remarked that he didn't see why I couldn't get out these slides as fast as Houghton did. That boss was a brute. He is a dead brute now.

Mr. Osborne's rather extravagant laudation of peening and his somewhat exaggerated story of the wonders that can be done with it may have a misleading influence with those who have not had much experience in this direction. At the best the operation of peening is a makeshift, and is never a strictly legitimate mechanical device. It straightens or bends only by putting unnatural and antagonistic strains in the piece operated upon. He speaks of straightening piston rings by peening on the inside. He could straighten such rings by planing a number of small cross grooves in the inside with a depth equal to, say, a half of the thickness of the ring and then driving a wedge into each of the grooves, thus producing a compressive stress on that side and a tensile stress on the other side, but it would hardly be necessary to tell anybody that the ring would be considerably weakened by the process. It does, however, seem proper to remind Mr. Osborne's readers that peening distinctly does not strengthen the piece to which it is applied, but just the opposite.

Once I became foreman of a shop where they handled and sent out lots of shafting. The shafting was usually tried in the lathe before it was shipped, to see that it was straight and true. It was no unusual thing to find a shaft an eighth of an inch or more out of truth, and they were in the habit of straightening in such cases by peening or stretching the concave side. In this way they easily got the shaft true, but when it was set up and was worked with anything like a full load it would soon be as crooked as ever. Even if run light, the weight of the shaft itself, if the hangers were not close together, this weight acting as the shaft turned around alternately to compress and then to extend the opposite sides, made the shaft forget all about the peening. I stopped the peening and insisted that all shafting should be straightened in the press, and the shafting record of the shop began to improve at once. The man who invented peening was not much of a benefactor after all.

TECUMSEH SWIFT.

Dies for Jewelers' Work.

Editor American Machinist:

In the sketches two dies are shown for producing an article of jewelry, Fig. 1. Fig. 2 shows one of the forming dies, of which there are right and left. Fig. 3 represents the punch of the perforating die, and Fig. 4 is the perforating die itself. The blanking die, being of the ordinary type, is not shown; the perforating die, however, might be of interest to toolmakers who find it difficult to obtain satisfactory results on small work, where the slightest difference in the distances between the holes is liable to interfere seriously with the assembling.

The perforating die should be made of tool steel and planed to an even thickness, for reasons shown later. The sample, or master blank, is drilled as in Fig. 1, great care being taken not to spring the punching while drilling it. To make sure that a frail punching does not change its shape either in drilling or in handling, I have found it to be good practice to try the finished sample in the blanking die, before transferring the holes to the perforating die.

When the perforating die blank has been finished on the surface and coppered, the sample is held to the blank, not clamped, and one hole is spotted off. Then a somewhat smaller drill is used for drilling the hole about an eighth of an inch deep and the hole is then rammed to the desired size. This done, the four perforating punches *iiii* are made, and one of them is inserted in the die through the master blank. Then the next hole is spotted off, and the operation is repeated until the four holes are in place. The holes are then scribed off on the back of the die by means of an angle plate and surface gage and a suitable larger drill is used for removing the surplus stock. Then the holes are reamed out with a taper reamer. In order not to ream the holes too large, it is always well to drill the master blank with a size smaller drill and finish the holes to the desired size with the taper reamer. In this case, however, the punches cannot be used for laying off the perforations, as described before, and pins have to be filed down to locate the holes. After the die has been drilled and tapped for screws *K K* and the dowel pins *e e* have been provided for, it is ready for hardening.

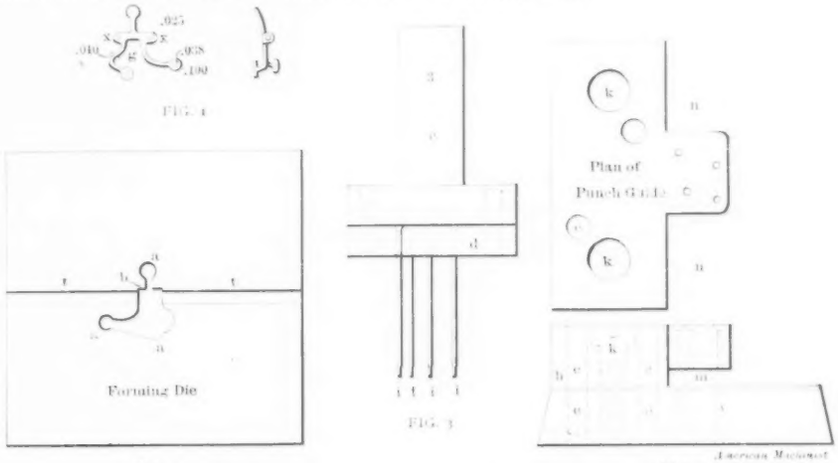


FIG. 1 FIG. 2 FIG. 3 FIG. 4

PUNCHING AND FORMING DIES FOR JEWELER'S WORK.

The guide plate *h*, covering almost the whole of the die, should also be made of tool steel. Since the life of the die, as well as the quality of the perforations, depends entirely upon the alinement between the guide plate and die, it is hardly necessary to state that it should be made very carefully and none of the toolmakers' pet sins, such as having chips under the work on the drill-press table or using badly-ground or worn-out drills, are to be indulged in.

In the first place it is of importance to have it bear nicely on the die, which should be ground off after hardening, as this operation invariably leaves high spots on its surface. After it has been finished all around, it is clamped to the die, care being taken that no chips lodge in between the bearing surfaces. The clearance holes for the screws *K K* are drilled and counterbored for the heads. The screws *K K* are used to clamp the guide plate to the die and the holes for the dowel pins *e e* are drilled. The dowel pins, which should be very tight in the guide plate, and loose yet without the slightest play in the die, so that the guide plate may be taken off with the fingers, are then put in place.

After the guide plate has been screwed to the die in the same position it will occupy when in working order, the holes for the perforating punches *iiii* are spotted off through the die. The plate is then removed from the die and the holes are finished to the size of the bodies of the punches. Recesses *m* and *n n* are then milled in.

The next thing in order is the punch-holder, Fig. 3. Part *c*, made of cast iron, is turned; part *d* is the machine-steel punch plate, secured to *c* by two screws and two dowel pins. As in Fig. 4, the dowel pins should be loose in *d* and tight in *c*. *d* is clamped to the guide plate and the holes for the punches *iiii* are spotted off through it. The punches *iiii* should fit snugly in *d*.

The last part of the perforating die is the sheet-steel plate *z*. This gang plate is clamped to the die and drilled for *e e* and *K K*. The guide plate is then screwed down and the holes *iiii* are drilled from the back of the die. Then the master blank is fastened to the gage plate through the holes and its shape is marked off. When filing out the shape of the punching it is advisable to do so slightly tapering, so that the work will fall in easily.

This kind of perforating die has many advantages. There are a large number of them in use in the shop where I am employed, and they seldom give any trouble. Its greatest advantage, however, is that it may be set at a moment's notice. A number of the small punches can be made at a time, and if a punch-holder breaks it is only necessary to unscrew the punch-holder and slip a new one in. It will be notice that only a small distance between the die and the guide plate is provided for pushing the work in place and removing it after perforating. This, however, will cause no trouble if the operator uses a pointed wire for pushing the work into the gage plate and holds it under the perforated punching as the punches ascend, thus preventing it from falling back into the gage plate.

The forming die shown in Fig. 2 is quite simple. The master blank is placed on the die and the shape is lined off. Now the holes *a a a* are drilled and the surplus stock is filed away clean through the die. To obtain the proper width at *b*, Fig. 2, a sample is bent up at that portion. The inside measure plus twice the thickness of the stock will be the required dimension. A groove *t t*, serving as a guide for the bosses *x x* completes the die, which is then ready for hardening.

Before proceeding any further, a perfect sample with all the curves and bends is made. A hardened tool-steel plunger, filed away on top to fit the lower side of the sample and brought to the surface of the die by a helical spring, is not shown in the sketch. The punch, also not shown, fits the upper side of the sample and completes the forming die. As the holes in *x x*, being too close to the bend, draw out of shape, they are punched a few thousandths smaller and then reamed to the proper size.

There is always more or less experimenting necessary in making a forming die of this character, and since the plunger may be taken out and changed before hardening, until it just suits, the advantage will appeal at sight. It is almost impossible to misplace the work, and anyone can set the die without any trouble, thus doing away with the annoying experience of spoiling a number of the punchings before getting it set. FRANK GREINER.

Holding Babbitt—End Stops for Crane Runways—Substitute for Slides.

Editor American Machinist:

I have come to the conclusion that nothing so surely sets me scribbling for your columns as a chance to disagree with some of your other correspondents. I hope this is not entirely due to a natural perversity on my part and that when I come in opposition to ideas set forth by others I shall be able to give good reasons therefor.

The particular thing I am up against now is the method of holding babbitt described at page 234 by Mr. Wertheim. His way is good, but it necessitates the use of cores, while the one we adopted some time ago, shown in Fig. 1, avoids cores in all cases where the box is drawn from the sand endwise, as occurs on nearly all main frames and sides. This method is easy for the patternmaker, gives the molder no extra trouble, the castings clean easily as there is no core sand in the pockets, and while the babbitt is securely held it is easily removed by chipping a groove *around* the box at the center. The accompanying sketch will, I hope, explain it fully.

In the same number, at page 241, is an end stop for a traveling crane which is claimed to be not only good but cheap. I have no fault to find with the quality

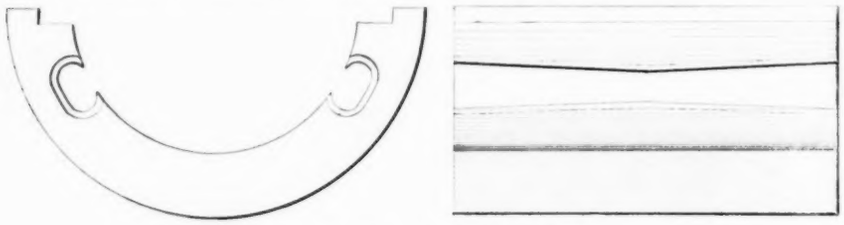


FIG. 1. HOLDING BABBITT IN SHELLS.

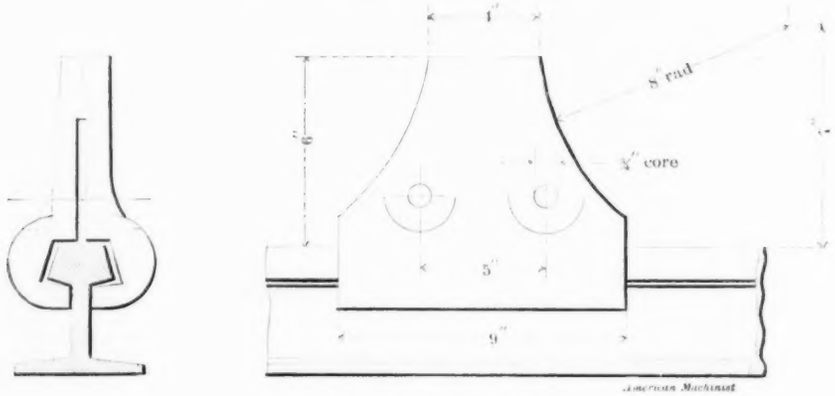


FIG. 2. CRANE RUNWAY STOP.

of the stop, but if, as appears from the cuts, it is made up of five ⅞-inch and two ½-inch plates held together by the bolts, it does not come up to my idea of cheapness.

We have been building a traveling crane for many years that is used principally in stone sheds for handling granite and marble and where the service is severe and conditions most unfavorable. We have never had any trouble from the stop shown in Fig. 2, and it is about as cheap as anything of the kind could be, consisting of two rough castings and two bolts without so much as a drilled hole. It "fills the bill" perfectly.

At the time we began building these cranes the back numbers of the AMERICAN MACHINIST did not contain all the good things that have since appeared on the efficiency of worm gearing, strength of winding drums, proportions of hoisting hooks, etc. The mechanical text books are singularly reticent on many of these points, and we had to depend on judgment and horse sense for some of the "formulas" we applied in designing the earlier models. We could find no information regarding hooks of a capacity greater than half the maximum load we had to lift, but we thought if any part was to break it had best be the hook, so we made this the element of least resistance, like the "pop out" cylinder head of early Westinghouse engines.

To avoid duplication of parts and to keep within the space allowed, it became necessary to move the hoisting worm and its shaft bodily across the face of the worm gear. This was contrary to all known precedent and obliged us to use a worm gear having a straight face, but we decided to give it a trial and it has never given any trouble. The movement takes place while the worm is running and is of frequent occurrence, but it has proved to be very durable and efficient. Not as much so, perhaps, as a hobbed gear, but the advantages of the latter were more than offset by the gain we made in simplicity of design and small space required.

I have been looking at the substitute for slides at page 447, as it is a movement I have long been hunting for, and, while my before-mentioned perversity will not allow me to take it as I find it and call it good, it seems to require but a slight modification to avoid the difficulties of construction mentioned by the editor and also to avoid the pins working in slots which seem to me to be worse, mechanically, than the original slides the movement is intended to displace.

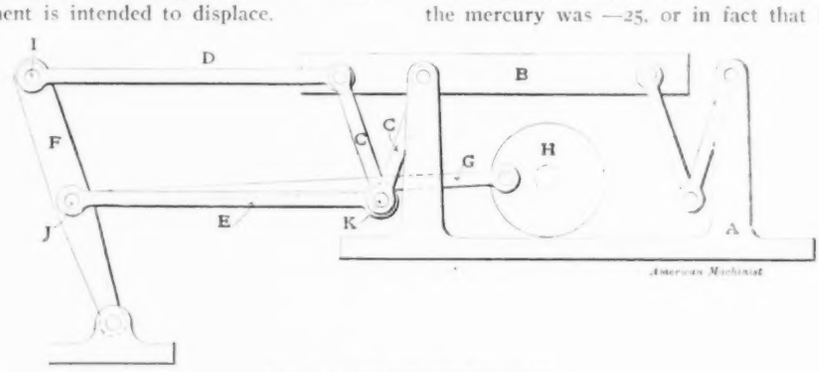


FIG. 3. SUBSTITUTE FOR SLIDE.

Any device which will cause the lower end of the links *C C*, Fig. 3, to travel one half the horizontal distance traveled by the upper end of said links should insure movement in a straight line to the platen *B*. I believe the connections shown in my sketch will accomplish this, though I had doubts about it at first on account of the angularity of the connections *D* and *E*. I afterward decided that the combined downward swing of the pin *K* and upward swing of the pin *J* would be just equal to the upward swing of the pin *I*, which would keep the angularity of the two connections equal, as they are of equal length.

I have just the conditions Mr. Warman speaks of to contend against—heavy work, water, dirt and grit, and a slide is out of the question. Perhaps someone who is "way up in P" in higher mathematics will demonstrate that I am wrong entirely, but I expect soon to have a chance to give this movement an actual trial, and I shall be disappointed if it does not give a parallel motion. At the same time I do not imagine any combination of links will ever turn the good old trustworthy slide out of business and make it look like one of Tecumseh Swift's egg shells.

E. R. PLAISTED.

The "Frost or Friction" Query.

Editor American Machinist:

Your correspondent, "Transmission," at page 445, tells of his fifth of a mile of line shaft, and how hard it is to drive in cold weather, and closes his letter with an interrogation point, but gives very few data on which to base a solution of his conundrum. I find room, however, very early in his letter describing that remarkable line shaft, for exclamation points.

"Transmission" speaks of getting his bananas by express, while we in Youngstown receive them the same as the Englishman gets his jokes—*i. e.*, by freight—but it is a case of transportation, in either instance, and if cold weather affected locomotives and cars, as "Transmission" imagines that it does his shaft, there would be a banana famine all over the United States, in latitudes north of the Ohio River. I have never seen it stated that an engine would pull four times as many cars in the summer time as in the winter, when the mercury was —25, or in fact that its efficiency was perceptibly changed by varying temperatures. The following quotation is from Professor Thurston's "Friction and Lost Work in Machinery and

Mill Work," page 321, and seems to be appropriate here: "The coefficient of minimum friction is found usually nearly constant over quite a wide range of temperature."

It is a fact, however, that friction does vary more than any other element in industrial mechanics, but the instance of this line shaft is extraordinary, and I respectfully suggest that the owner of it send for W. Osborne's boy, Joe, to go and examine it and adjust it, or change the design so it will automatically compensate for its change in length, due to change of temperature. In other words, make the requirements match the conditions, and when he gets through, if he does not run that line with 20 horsepower, send for Mr. O. himself; and it goes without saying, if the Oil Regions are two less in population for a few days, that the readers of the AMERICAN MACHINIST will get a chance to read an interesting echo from elsewhere.

Youngstown, O. J. H. DUNBAR.

Shade Lines on Drawings.

Editor American Machinist:

Intensifying the lines on mechanical drawings which represent edges casting a shadow is a custom which seems so necessary to many that to question its propriety will be considered rank heresy.

It must be conceded that shade lines improve the appearance of a drawing from an artistic standpoint and for this reason they are retained in many cases, as in drawings to be published or to be submitted to outside parties.

Let us consider, however, the case of drawings solely for shop use. It will be admitted that here a draftsman should spend no time in mere adornment of his drawing, no matter how great his personal satisfaction in doing so. There can be no doubt that it takes more or less additional time to shade a drawing. Hence, if shade lines do not render a shop drawing clearer, they should be abandoned. If they do, they should be retained without question.

Most draftsmen are incapable of giving an unbiased opinion in this matter. One brought up to use shade lines always considers it unwise parsimony to prohibit them. One brought up not to use them always considers that they require a useless expenditure of time.

The only way to decide the matter, therefore, is to observe the effects of actual experiment. Originally shade lines were used almost universally, but recently there has been a tendency to drop them. If drawing offices where shade lines have been dropped show no tendency to resume them and if the tendency to drop them is growing, we must conclude that in the long run shade lines are useless on drawings intended solely for shop use.

In order to ascertain the current practice in regard to this, as well as many other disputed points in drawing-room practice, Professors Barr and Coolidge of the Department of Machine Design, Cornell University, have been collecting information from various reputable drawing offices. This research is still in progress, and when completed will be published in full. Out of 47 representative drawing offices heard from to date, 23 use shade lines on detail drawings always or occasionally, while 24 never use such shade lines.

Such a showing seems to cast some doubt on the usefulness of shade lines. It does not seem possible that such a large proportion of the offices heard from would discard shading if it would enhance the clearness of drawings in the least.

SANFORD A. MOSS.

Cornell University.

The Seventh Annual Convention of the National Association of Manufacturers.

This association assembled for its annual convention at Indianapolis, April 15, the attendance being large and representative. It is not intended in this report to give a chronological account of the proceedings, but to touch upon such subjects only as are of special interest to our readers. In cases, of which there were several, in which matters were postponed to be again taken up at later sessions, the order of procedure will be ignored in order to give the conclusions arrived at in as compact form as possible.

The convention was called to order in the hall of the House of Representatives in the State Capitol by D. M. Parry, chairman of the general and executive committees. After the usual addresses of welcome, the convention listened to the reading of the President's Annual Report, which was a printed document of twenty-seven pages. The report began by a reference to the satisfactory condition of trade and proceeded to state that conditions for the past year have not been favorable to extension of foreign trade in manufactures, these conditions being the frequent inability to meet the urgent demands of the home market. Exports of manufactures reached their maximum average of $36,000,000 per month in 1900, from which figure they have, largely for this reason, shrunk to an average of $28,667,000 for the eight months ending February 28, 1902. The most serious loss is in iron and steel, for which items the shrinkage is $2,625,000 per month. In commenting upon this, the president urged the importance of maintaining foreign connections and caring for foreign customers.

From this the report goes on to consider the subject of Commercial Reciprocity, reciting the interest in the subject which developed at the convention of last year, the history of the National Reciprocity Convention of last November, and the resolutions adopted by that body. The report then points out the new departure of the government in adjusting the Cuban problem through special legislation and points out that this precedent will probably result in progress in reciprocity being hereafter made in this manner rather than through the negotiation of treaties. This is considered to possess certain advantages, but it is also recognized that it "practically invites a continuous tinkering of the tariff." The action of the Reciprocity Convention in endorsing the movement for the creation of a Federal Department of Commerce and Industry was considered quite as important as its action on the subject for which it was called together.

The title of the proposed department was changed to that of the Department of Commerce and Labor in order to obtain the support of the labor organizations. This change has, however, had an effect the direct opposite of that expected, as the representatives of those organizations object to the union of their interests with those of commerce and manufacture and aim at securing an independent department of their own. At a later session it appeared that the title of the department had been again changed to the one originally proposed for it.

Following this the shipping subsidy bill was taken up and supported in accordance with Mr. Search's well-understood beliefs.

The next topic was that of the Isthmian Canal, this section of the report dwelling largely upon the unfortunate confusion which had been injected into the subject by the Panama route.

Following the discussion of the canal comes the Reorganization of the Consular Service—a subject which has always occupied a prominent place in President Search's annual reports. Increased interest in the matter at Washington is noted, although no forecast is attempted regarding the probable outcome. The measures now before Congress are of course approved.

The next topic discussed is the Compulsory Use of the Metric System. This paragraph is a brief one, but it is clear from it that President Search understands the present bill to be compulsory in its nature. The Executive Committee has appointed a special committee for the investigation of this subject, which committee is now at work, but it was announced that it was not yet ready to make a report.

The Anti-Injunction Bill, as a measure now before Congress is popularly known, was next considered. No specific action is recommended in this portion of the report, although it is noted that it has not heretofore been the policy of this association to deal in any way with labor troubles.

With the above topic the Eight-Hour Law is naturally connected in the report. This proposed law requires eight-hour service only on the part of workmen engaged in contract work for the government and provides a severe penalty for its infraction. The difficulty of carrying out

this law in cases where only a portion of the work being done in a given factory is for the government, is pointed out.

Foreign Corporation Laws, by which are meant the attempts of various States to tax corporations from other States doing business within their own borders, are next considered. In response to appeals for advice, the association has advised its members to abstain from the payment of these fees. It is an established fact that no State has instituted litigation against any manufacturer for the collection of these fees, and the constitutionality of these laws is thus undetermined. Meanwhile it is not clear how the association can originate a case for settlement. The provision of some of these laws that corporations refusing to pay the fees shall have no standing in State courts, is considered to be null and void.

The next topic discussed is Interstate Commerce Legislation. On this topic the appointment of a special committee on insterstate commerce law is recommended.

The next topic, which is dealt with at greater length than most of the others, is that of Commercial Education, in which President Search is known to be vitally interested. The lack of facilities for acquiring a commercial education in this country is pointed out. The plan suggested in the annual report of a year ago for an examining body maintained by the association which should recommend courses of study and issue certificates after the passing of suitable examinations, is discussed, and it is pointed out that this plan is followed successfully in England. This plan has met the approval of the Executive Committee, but lack of funds has prevented any attempt being made to carry it out. The application of the methods of the correspondence schools to this line of instruction is then discussed, and the organization of such a correspondence school by the association is suggested. Immediate action on these suggestions is not, however, contemplated.

The Foreign Sample Warehouses, which the association established at Caracas, Venezuela, and at Shanghai, China, are then taken up. Both of these enterprises are admitted to be failures and have been abandoned by the association. The cause of the failures was in both instances the disturbed political conditions of the countries. These failures are very much regretted and the opinion is expressed that on its merits the sample warehouse idea is one of the most thoroughly practical methods of developing trade in which the association can engage.

Several lines of activity of the association are then discussed together, namely, the International Freight Bureau, the Bureau of Information, and the Publication Department. The Freight Bureau acts as a forwarding agency for the members doing business abroad and not only does this effectively, but, it appears, also secures a material reduction in transportation charges.

The last topic discussed is the Needs of the Association. It is well known that Mr. Search had positively declined re-election for another year, and for this reason he felt warranted in making some recommendations which otherwise he might not feel like making. The greatest need is that of a greater revenue and it is recommended that the annual dues be increased from fifty dollars to one hundred dollars. It is pointed out that while the association has made both ends meet, it has been able to undertake but a small part of the work which legitimately falls within its scope. Regarding the future, the suggestion is made that semi-annual conventions for the discussion of special topics be held. The success of the Reciprocity Convention furnishes the precedent on which this recommendation is based. The final suggestion made is that there be an increased number of permanent committees in order to relieve the president of some of the burdens and responsibilities which are now placed upon his shoulders.

Following the presentation of the president's report came the report of the treasurer. This report, in addition to making a detailed statement of the finances for the past year, gives a resumé of the receipts from membership dues during each year of the association's life. Beginning with $21,250 in 1895, the receipts steadily and rapidly increased until 1900, when they amounted to $53,012. During the following year there was a slight shrinkage, the figures for 1901 being $51,150.

Following the treasurer's report came the report of the Foreign Freight and Transportation Bureau, the report being intended more especially to call the attention of members to the advantages offered by this bureau, which appears to be one of the most practically useful features of the association. During the past year the use made of this bureau by members has increased about 100 per cent.

Following the presentation of these reports came the discussion of the president's report. Most of the topics of that report were discussed at length, although that discussion was not always direct. In many cases the discussion was directly on some resolution brought in by the Committee on Resolutions. In what follows no account will be taken of these two methods of discussion—the chief arguments and the conclusions alone being given.

RECIPROCITY.

While this topic was discussed with a good deal of earnestness, it did not occupy the commanding place on the program that it did at last year's convention. Moreover, there were few or no opinions expressed leaning at all in the direction of free trade or even to lower general duties. One or two members asserted that their own interests were independent of any tariff protection, and that they would be willing to see them removed. They also believed that ome other industries were in the same position, the iron and steel industries being specifically mentioned. The general temper of the discussion, however, was that where duties were removed in such instances, it should be only in exchange for similar concessions by other countries. In connection with the discussion of this topic, a line of usefulness which is anticipated for the new Department of Commerce and Industries was indicated. It was believed that tariff concessions and reciprocity arrangements would largely originate in such a department and that they would be much more intelligently handled than when, as now, subject of the haphazard methods of Congress. In this connection, however, some interesting statements were made regarding the intelligence and ability of Congressmen and especially regarding their devotion to the public interests and their willingness to listen to delegations.

NEW FEDERAL DEPARTMENT.

Disappointment was expressed that at the recent hearing in Washington so few members attended to lend force to the views of the association. The opinion was expressed that the commercial interests of the country can have the department if they will make their wants plainly known, and that with such a department in existence the reciprocity program would develop rapidly.

METRIC SYSTEM.

The discussion of this topic occupied perhaps more time than any other and at times it was decidedly animated. It was the universal understanding of the members that the bill now before Congress is mandatory and this impression was in fact so strong that a categorical statement that the Attorney-General has rendered a contrary opinion made no appreciable impression. The manufacturers of miscellaneous goods, who largely compose the association, were as a whole disposed to look with some favor on the system, though all opposed its compulsory adoption. No active opposition to the system as such developed until the machinery interests began to be heard from, and the statements made by them unquestionably furnished a good deal of information to the other members. It had been stated that the adoption of the system was a necessity in connection with the future of our export trade, and to this Mr. Gates of the Allis-Chalmers Company, Mr. Geier of the Cincinnati Milling Machine Company, Mr. Smith of the Ferracute Machine Company, and Mr. Sellers of William Sellers & Co., made reply. Mr. Gates stated that his company exported more machinery than any other corporation in the United States and that they had not found it necessary to make any changes whatever on machines sent to metric-using countries. Mr. Geier stated that the only

changes which they had found it necessary to make were in the elevating and cross-feed screws of the platen. Mr. Smith had found it necessary to make similar trifling changes only. Mr. Stillman of the Watson & Stillman Company pointed out that the entire machine-building industry was practically a unit against the system and explained the enormously greater importance of the matter to those industries than to others. Mr. Halsey urged that the entire metric propaganda was a case of magnifying a mole hill into a mountain. He urged that the savings due to the system in making computations were confined to a few and that the time saved when compared with the total population was of no economic importance. He pointed to the experiences of machinery manufacturers engaged in the export trade as proof that the argument based on the supposed needs of the export trade were equally trifling in importance. Mr. Fairbanks of the Fairbanks Scale Company suggested that the adoption of the system for measures of weight and capacity would be a far less serious matter than for measures of length. His company would welcome such a change. He thought that too great attention had been concentrated upon measures of length and recognized the serious nature of a change in this direction.

As stated in the president's report, the association has a committee at work on the matter, and inasmuch as action by the association in advance of a report by this committee would be scarcely courteous o the committee, no resolution upon the subject was passed.

The committee referred to above, which is composed of Theodore C. Search, William Sellers, Alba B. Johnson, James M. Dodge and J. D. Cox, Jr., has prepared a list of questions which are to be circulated among the membership, and on replies to these questions their report will be based. Following is the committee's list of questions:

1. Would the adoption of the metric system tend to increase foreign business in the lines you represent?

2. Would the adoption of the metric system be beneficial to domestic business in the line in which you are engaged?

3. Would the adoption of the metric system by our government, for any or all of its departments including customs houses, arsenals, navy yards and public works, be detrimental to your business?

4. Would it induce the adoption of the metric system by manufacturers and others in private transactions?

5. If our export business should largely increase with countries using the metric system—(*a*) would such increased business lead them to accept our English measurements with less objection than hitherto, or (*b*) would it lead to the introduction of the metric system by this country under the operation of the natural laws of supply and demand, without further legislation?

6. Assuming the desirability of an international system of weights and measures, is it of sufficient consequence to justify incurring the following disadvantages: (*a*) The abandonment, or necessity for rewriting, all non-metric engineering literature? (*b*) Changing our small tools and standard gages now based upon the standard inch? (*c*) Abandoning the inch with its binary divisions in common use, such as the half, quarter, eighth, sixteenth, thirty-second, sixty-fourth, and the decimal divisions of the inch? (*d*) Abandoning the present standard screw threads, which are based upon the inch?

7. Should Congress enact any law to enforce the use of the metric system in any of the departments of the government?

8. In view of the fact that the metric system was legalized by Act of Congress in 1866, and has therefore been on a legal equality with the English system for thirty-six years, to what extent have you made use of it and what has been your practical experience with it?

At the suggestion of Mr. Halsey, President Search agreed to have the following questions added to the list:

9. To what extent have you found it necessary to adopt metric dimensions in the construction of your machines sent to metric-using countries in order to adapt them to the needs of your customers?

10. To how great an extent have you found the use of English measures in the construction of your machines an embarrassment in your efforts to secure trade in countries using the metric system?

11. Give an idea of the extent of your trade in metric-using countries since 1896 in order that an estimate may be formed of the value of your experience.

IRRIGATION.

Although not touched upon in the president's report, a Mr. Maxwell, who represented the Western irrigation interests, was given the floor and addressed the meeting on that topic, the result being the passage of a resolution endorsing the irrigation project when surrounded by restrictions which should insure the irrigated land being taken up by actual settlers and home seekers and not by speculators.

RESOLUTIONS.

Among the resolutions presented by the Resolutions Committee and adopted by the convention were the following:

One calling for meetings by each State a month before the annual meeting in order to bring out subjects needing discussion at the latter, and also in order to secure a full attendance; one calling for the Bureau of Transportation to issue a bulletin which should explain its usefulness to the association at large; one endorsing commercial reciprocity; one endorsing the department of commerce and industries; one consolidating the offices of secretary and general manager, the two being hereafter held by one man; one endorsing ship subsidies; one endorsing the Isthmian Canal, urging prompt action but without expressing preference as to the route; one condemning the bill popularly called the Anti-Injunction Bill; one opposing the passage of the eight-hour law as applied to government contract work. The chief objection to this latter law was the impossibility of enforcing it since it applies to all work done by sub-contractors. It was pointed out that a contractor who bought bolts and nuts for use on a machine which he was building for the government would be compelled to assure himself that these bolts and nuts had been made by workmen who were at work only eight hours a day, and legal opinion had been given that the same would apply to the packages in which the goods were shipped, including the lumber and even the nails of which the packages were made.

CHANGES IN THE CONSTITUTION.

The Committee on Constitution reported a number of changes in that document, most of which were approved, but which it is unnecessary to give in detail here. President Search's recommendation that the annual dues be increased to one hundred dollars a year was not adopted.

ELECTION OF OFFICERS.

Following the consideration of the constitution, the election of officers for the ensuing year was held, the result being as follows: President, D. M. Parry, of Indianapolis; secretary, E. H. Sanborn, of Philadelphia; treasurer, Hamilton Carhart, of Toledo.

As a token of esteem to retiring President Search, who has occupied his office for six successive years, he was at this point presented with a superb piece of bronze representing two Western cowboys on their horses in the act of throwing a lasso. The presentation was a complete surprise, the president stating that the object and its pedestal which stood upon the floor suitably veiled had only attracted his attention by reason of its being in the way. In reply he made a very happy speech in which he enlarged upon the the future greatness of the Mississippi valley in a way which must have warmed the hearts of his Western hearers.

After passing the usual series of resolutions and deciding upon New Orleans as the place of holding the next annual meeting, the convention adjourned.

It is claimed that the world's record for railway speed has been broken by the performance of a Chicago, Burlington & Quincy train recently, which ran 14.8 miles in 9 minutes, or at the rate of 98.7 miles an hour. Trains have previously equaled, or perhaps a little surpassed this speed, but only for very short distances—something like a mile or two. This latest performance is claimed to be by far the highest rate attained for any considerable distance.

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Effect of the Use of Machinery.

It is announced as though it was a matter of considerable importance, that Mr. Wm. Abraham, M. P., who is described as one of the ablest and most influential labor leaders of Great Britain, has been visiting America and has changed his views regarding the influence of machinery upon the interests of workingmen. It seems that Mr. Abraham, whose field has been particularly among the Welsh miners, has until recently been of the opinion that the introduction of labor-saving machinery has been an unmixed evil to workingmen; but as a result of his visit to America it seems he has changed his mind about this and believes that machinery is a blessing to them and that it should be introduced as rapidly and used as fully as possible. Needless to say that a great many men have discovered this truth before, and a great many have discovered it in England without finding it necessary to come to America to do it. The fact is that while the beneficent effect of machinery is perhaps not as plainly visible in Great Britain as it is in America, it is still quite discernible to those who are in the habit of looking a little beneath the surface of things. It is plain as anything can be that machinery and the use of it does not injure workmen in Great Britain, but monopolies and special privileges do injure not only workmen there, but others who are not workmen, and all, in fact, who do not themselves participate in and receive the benefit from such monopolies and special privileges; and the same truth is apparent here.

Over-Education.

We do not suppose that Justice Hatch, who delivered an address at the tenth annual meeting of the Dwight Alumni Association in New York a short while ago, has been reading much, if any, of the discussion that has taken place in our columns and elsewhere regarding the effect of technical and other education upon engineers and those desiring to become engineers. But in discussing education as related to the profession of law, he expressed very much the same ideas that have been brought out in connection with the first discussion referred to above. He stated it to be his belief that many lawyers are at the present time over-educated. He did not think that a university education was of much benefit to them, and said that where a student had been put through all the preliminary grades of preparatory study and had gone through a university he was prepared to take up his law studies at a time when he should be examining men in supplementary proceedings and collecting bad debts; which, it will be perceived, is an expression of precisely the same idea that has been advanced in mechanical matters, and is the same opinion which is held, for instance, largely in Germany, where it is thought by many that one trouble with Germany's industrial operations is that her younger engineers are in school studying under a more or less arbitrary and dogmatic professor at an age when they should be in actual work in their profession, learning to take the initiative and to do things on their own account, and that as it is they do not get into actual work until the age at which they can acquire initiative has gone by.

Engineers in the American and English Navies.

What can be the reason why the line officer of the navy, wherever bred or found, systematically belittles the work of the man in the engine room? Why should he persist on the one hand in thrusting responsibility without corresponding authority upon engineer officers and on the other in assuming responsibilities for which he is not fitted by training or education and the natural results of which can only be disastrous, as the reports of Admiral Melville on the condition of much of the machinery of the navy show them to have been?

Our readers have been kept informed regarding the progress of the controversy in our own navy, but, bad as is the condition of things, there is some left-handed consolation to be had from the knowledge that it is equally bad elsewhere, and especially in the British navy. Indeed, while at least a disposition—even though ill-advised and unfortunate in its outcome—has been shown to rectify matters at home it appears that the present tendency in England is toward a still worse condition of things.

We learn from *Engineering* of February 14 that the Admiralty has recently issued an order of which the following is a part:

"Gunnery lieutenants to have charge of and be responsible for the care and maintenance of all gun-mountings, as well as for the hydraulic fittings in connection with the guns and hydraulically worked machines (outside the pumping engines) at present used for serving them.

"Torpedo lieutenants to have charge of and be responsible for the care and maintenance of all dynamos, electric motors, electric lighting, Whitehead torpedoes, and discharges."

By this order duties of a strictly engineering character are placed upon naval lieutenants. The care of the machinery described was formerly in charge of the engineering department, and it appears that this action is a makeshift action intended to meet the difficulties brought about by the policy of which it is a part, but which can have no other effect than to intensify them. The disabilities under which English naval engineers labor has had its natural effect. There appears to be no doubt that both the quantity and quality of personal material offering itself for the engineering branch of the navy has fallen off, the fewness of candidates at present making it necessary to accept anything that comes forward. This is,

in effect, officially acknowledged, for the order of which the above quotation is a part, states that the new duties are transferred to the gunnery and torpedo lieutenants in order that the engineers may have more opportunity to attend to other matters. In other words, the Admiralty adopts a policy which cripples the engineering department and then endeavors to meet the natural effects of its policy by extending it!

While, however, the present tendency in England appears to be worse than here, there is much more reason to hope for better things in the future there than here. Various societies of shipbuilders are becoming interested in the matter. Important papers have been read and discussions have been held and there is good prospect that united action will be taken by the societies and a presentment be made to the Admiralty. The similarity of the conditions in the merchant and the government marine is so decided that these societies can speak with an authority comparable with that of the Admiralty itself, while British interests in the merchant service are so vast that the protests of these societies can scarcely go unheeded. We have no influence in this country to compare with theirs. The average American knows little and cares less about the controversy or its merits. In England the merchant and the royal navies are equal subjects of public interest. We have neither leaders nor interested public to be led. England has both, and we shall be much surprised if the matter is not settled right there long before it is here.

That there are those in England who do not take so hopeful a view of the case, however, is shown by a contributed article in *The Mechanical World*, in which the writer, among other things, says:

"The policy of the press as regards the navy is simply 'more ships.' Some call for battleships, others cruisers, while Lord Brassey intends to devote the remainder of his life to an attempt to convince the country that it requires more auxiliary cruisers. One writer lays it down that the British fleet must be equal in numbers to those of the combined fleets of Russia and France. Others insist that the numbers must equal those of Germany, Russia and France. They each make out a list of the battleships and cruisers in the fleet of this country, and set against it the lists of the battleships and cruisers of the foreign combination, and whichever has the longer list is said to be the stronger side. The fittings of the machine rooms in the opposing fleets are not compared; nor is the state of the engine-room staff, as regards management, looked into. It is enough for the critics who call for the money that the list of British ships is not quite so long as the list of the names of the foreign combination. Thus, while millions are voted year by year simply to increase the length of the British list, the fleet so built consists of ships fitted with condemned boilers, of torpedo craft which must be brought into harbor at night for safety; that the engine-room staffs are managed by men who have the responsibility without the control is a fact which is never considered.

"No one outside the navy, no engineer in the efficiently managed workshops of England, could imagine the conditions under which the chief engineers of the fleet are expected to perform their duties. The most ordinary foreman in one of the smallest departments of any engineering concern has always the power of engaging and dismissing the men under his charge; but the chief engineer of the navy has no authority over the lowest subordinate in the engine room. Sir Fortescue Flannery or Mr. William Allan may talk as they please; they may demonstrate as often as they like the absurd condition of things. The old sea lords never listen to them. Reform may be hoped for; but it never comes, and while we are waiting, the sea lords have gained the ear of the present First Lord, and orders have been issued making the new status of the chief engineer worse than the first."

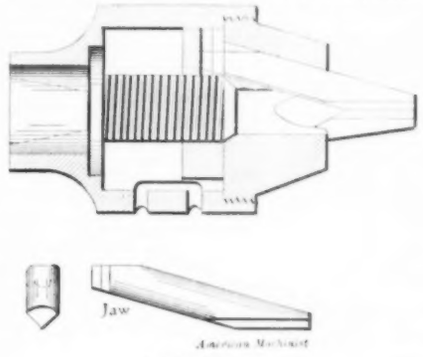
We referred a short time ago to the order of the President preventing government employees from attempting to influence legislation, and the effect of this order upon the efforts of certain labor union officials to secure better terms of employment in navy yards and other places. It is now stated that President Roosevelt has himself modified this order, or at least given an interpretation of it, under which it will not interfere with such things, he stating that the order did not refer to the efforts of organizations as bodies. He has applied this specifically to the efforts of certain government employees who were trying to secure the passage of a law relating to superannuated employees and designed to benefit them. Their efforts to secure such legislation are to be permitted under the new law.

Theodor C. Search, who recently retired as president of the Manufacturers' Association, has been mentioned in connection with the head of the department of the government to be known as the Department of Manufactures and Commerce. There has been some objection to him for this position on the ground that his attitude toward foreign trade would not be calculated to develop America's foreign trade—at least so far as was indicated by his han ling of the recent reciprocity convention in Washington. Those who favor reciprocity do not generally consider that the convention in Washington accomplished anything in favor of reciprocity or of more liberal arrangements for conducting foreign trade, and many of them are inclined to think that for this failure to advance the cause of foreign commerce Mr. Search is chiefly responsible. Though this, on the other hand, is denied, it is a fact that Mr. Search has expressed his entire approval of the reciprocity convention and what was done by it.

Some New Things.

DRILL CHUCK.

We show herewith in section a new chuck for holding drills or small work. The hub of the screw—shown at the center

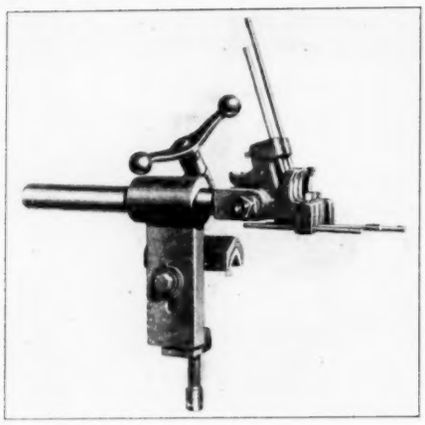


DRILL CHUCK.

of the chuck—has a taper hole at the back end in order that it may be mounted on a mandrel fitted to the lathe or drill press spindle. The chuck body, or outside shell, which is knurled and provided with holes for a spanner wrench, can be turned freely about the hub of the screw. This screw has a left-hand thread and runs through the nut shown near the front end of the chuck body. The nut has three radial T-slots, and in these slots fit the heads of the chuck jaws. The jaws are made of round steel and are carried in the nose screwed in the front of the shell. As the shell is rotated, the nut turning with it moves the jaws either out or in, thus gripping or releasing the drill. The screw and nut being left-handed, it will be seen that the heavier the cut on the drill, the tighter will the chuck hold. For, as the drill under the cut tends to hold the chuck back, the screw being driven by the spindle will force the nut ahead and crowd the jaws down hard on the drill. This chuck is the invention of Frederic P. Gates, of New London, Conn.

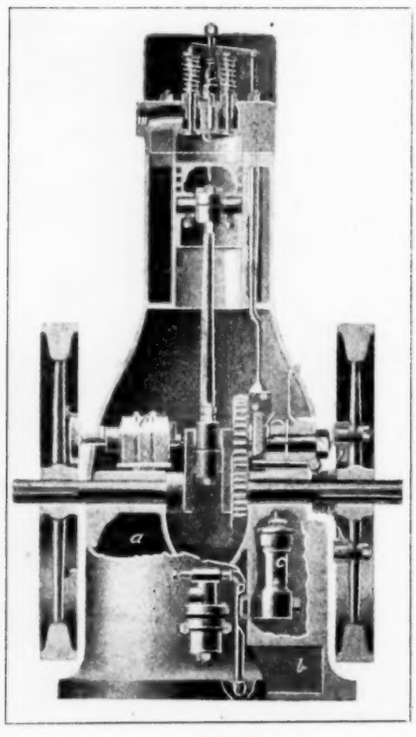
ADJUSTABLE MULTIPLE STOP GAGE FOR LATHE CARRIAGE.

The half-tone shows a stop or gage easily applied to an engine lathe for repetition work. It sets on the front "V" of the lathe and then is secured by the screw at the bottom. The front casting may then be slid up or down to the hight required, and it is fastened by the large nut in front. This casting has a split hub in which fits the large horizontal bar, the hub being tightened by the large inclined winged nut. The horizontal bar has a wide jaw in which are pivoted three or four more stops. These each carry an adjustable rod which may be set to any length required. These rods may be swung up out of the way, as two of them are shown, and they are brought down to the horizontal position singly, and the end



MULTIPLE ADJUSTABLE STOP OR GAGE.

then serves as a stop for the lathe carriage. In use the stops are each adjusted to a different length, to bring the carriage and the cutting tool into a different position for each stop, as, for instance, when facing the fronts of the successive steps of a cone pulley. If the cones do not come to the same position on the mandrel the main bar is slid along to accommodate it without changing the individual adjustment of the stops. In setting a piece in the chuck, this stop will be found a convenience in finding the lowest place on the face of a casting or in setting opposite points which have to be faced together. Many other uses for the device will readily suggest themselves. It is of course applicable to a planer, shaper or elsewhere. The inventor and patentee is Edmund J. Bowers, 2125 Ontario street, Philadelphia.



THE HAR DE MOTOR.

THE HAR DE MOTOR.

The Hardy Motor Works, of Port Huron, Mich., are putting out a very neat design of small gas and gasoline engine, of which we give an illustration. The engine is self-contained, even to the water and gasoline tanks, the former of which is at *a* and the latter at *b*. The water tank contains enough water to keep the engine cool for a day's run, the circulation being obtained by the pump *c*. At *d* is the mixer, which has no pump, as the mixture is drawn through it by the action of the engine. The ignition is by a small magnetic machine *e*, which, however, is not located as in the illustration, its place being outside the crank case. It is driven by the friction contact of its pulley with the driving wheel—a spring support maintaining contact at all times. The engine is of 1¼ horse-power at the normal speed of 400 turns per minute, which, however, may be varied while in motion from 200 to 600.

Papers for the Spring Meeting of the A. S. M. E.

The following is a list of the papers to be presented at the meeting in Boston, beginning May 27, of the American Society of Mechanical Engineers. The number of candidates for membership of all grades to be voted upon at this meeting is 125.

C. C. Tyler, Standards for Machine Screws; R. H. Fernald, Determining Temperatures of Exhaust Gases in Combustion Engines; R. H. Fernald, Working Details of a Gas Engine Test; Chas. E. Lucke, Liquid Fuel Combustion; Fred H. Colvin, Mech. Locomotive Stokers; V. E. Edwards, The Flying Shear; R. E. Curtis, Swiveling Joint for High Pressure Main; A. K. Mansfield, Improved Indicator Cock for Engines; Jno. D. Riggs, Cold Working Sheet Metals; H. M. Lane, Repairing a Broken Cylinder; Supplementary Report of Committee on Standard Pipe Unions; W. B. Smith Whaley, Electricity in Cotton Mills; Report of Committee on Standard Methods of Testing Steam and Gas Engines; I. E. Moultrop and R. E. Curtis, Construction of Atlantic Avenue Power Station, Boston; Gus C. Henning, A Roller Extensometer; C. R. Pratt, Elevator Safeties; R. H. Soule, Technical Index and File; Wm. R. Webster, Specifications for Steel Forgings, Castings and Boiler Plates; Albert Ladd Colby, Standard Specifications for Steel Shapes; F. M. Bowman, The Lowell Gas Light Company's Coal Pocket; Wm. H. Bryan, Some Details of Direct Connected Generator Sets; Geo. H. Barrus, Pipe Covering Tests.

Examination for Draftsman.

An examination of applicants will be held at the Navy Yard, New York, April 30, 1902, or as soon thereafter as practicable, for filling the position of first-class copyist electrical draftsman in the Department of Equipment, at $3.23 a day. Applications prepared according to instructions issued by Secretary Long are to be addressed to "Commandant, Navy Yard, New York," and delivered to him on or before April 29.

Mr. Richard Moldenke, secretary of the American Foundrymen's Association, announces that the headquarters of the association during the coming Boston meeting will be at the Hotel Brunswick.

A strike which had all the premonitory symptoms of a serious difficulty has been settled in the works of the General Electric Company, at Schenectady, owing to the fact that the strikers asked the mayor of Schenectady to act as an arbitrator. It is understood that as a result of his intervention the employees who had gone out (about 6,000), many of whom were not connected with any organization, have returned to work, and that the dispute over piece-work prices in the polishing department, which started the trouble, will be adjusted promptly on an equitable basis.

President Charles F. Thwing, of the Western Reserve University, has been making an investigation of the amount of salary received by graduates of the regular colleges and of the scientific schools. The result of his investigation tends to show that graduates of regular colleges received immediately after graduation better salaries, on the average, than those who graduated from the scientific schools, and that their advantage increases with the lapse of time; his conclusion being that the value of a liberal training, rather than a narrow one, shows itself more clearly as time goes on.

Personal.

C. E. Walker and C. Booth, of the Chicago Pneumatic Tool Company, have departed for Europe in the interest of the company.

D. A. Mason, M. E., and H. Sloan, M. E., have opened an office at 220 Broadway, New York city, for doing a general consulting engineering business in mechanical and electrical work.

Edward N. Hurley, formerly president of the Standard Pneumatic Tool Company, now a director in the Chicago Pneumatic Tool Company, sailed April 17 for London, where he will meet President J. W. Duntley, and complete arrangements for the sale of the International Pneumatic Tool Company, of London, to the Chicago Pneumatic Tool Company.

Obituary.

Samuel K. Treese, one of the best rollers in Western Pennsylvania, died at Braddock, Pa., April 13, fifty-two years old.

Owen McCabe, president of the McCabe Boiler Works, Newark, N. J., died April 17, sixty years old. Mr. McCabe was a native of Ireland. When a boy he was an apprentice in the iron works of L. J.

Lyons & Co., Newark, becoming foreman and later a partner. He bought out the entire concern two years ago.

John Auer died in Brooklyn, April 16, seventy-six years old. The Auer Iron Works, Brooklyn, were founded by him fifty years ago.

Job Johnson, for many years a manufacturer of fish-hooks, in which business he is said to have made half a million of dollars, died April 18, eighty-nine years old. His money had been lost in unfortunate real-estate operations.

William J. Baxendale, of the firm of T. R. & W. J. Baxendale, machinists, Rochester, N. Y., died April 8, forty-nine years old. Mr. Baxerdale was born in Utica, N. Y., learned the machinist's trade in Rochester and later with his brother engaged in business, building up a prosperous trade. He was fatally injured by being struck in the abdomen by a lever or crank of his automobile.

William A. Lockwood died at Yonkers, N. Y., April 19, eighty-two years old. Mr. Lockwood conducted a machine business in Yonkers before the Civil War. Later he was located in St. Louis, where he invented and manufactured a steam pump. He was later associated with John Baird, the naval architect. About 1870 he returned to Yonkers and became superintendent of the Otis elevator works, remaining connected with the works fifteen years. His death was caused by gangrene which followed the cutting of a corn.

Commercial Review.

NEW YORK, Monday, April 21.

MARKET NEWS AND NOTES.

In mentioning steam turbines last week we inadvertently stated the price to be about $10 a horse-power at 100 horse-power sizes, being given as figured at 50 per cent. above the average price of a high-speed engine of that size. We meant to quote the turbine price at $15 and the high-speed engine at $10. In neither case, however, do we wish to give the figures as other than a rough estimate mentioned for purposes of comparison. The turbine price is about $15 a horse-power based upon a particular make and we cannot speak for others.

Interest in the machine-tool trade is now focussing on the labor situation. May Day will be here in less than two weeks, and whether that season of floral and solar conviviality will be celebrated in the machine shops according to the program of the last two years is what the trade would like to know. It is generally conceded that the chief demonstration, if any, is likely to take place at Worcester, that tool-building center not having witnessed a proof of strength between the two opposing factions of last year, when so many of the localities were embroiled.

From the mercantile standpoint a strike this year would be more unfortunate than a year ago, since business is distinctly better and the pressure on shop facilities more urgent. The demand for machine tools, as indicated by the remarks of sellers in the New York market, is virtually as active as it has been ruling for some time and shows no sign of taking a holiday to accommodate strike conditions.

There is a stiffening tendency among prices of machine tools in some quarters. A well-known concern making grinding machinery intends to advance prices next month about 5 per cent.

It is rumored that a New England company which makes a general line of machine tools, running into heavy sizes, has decided on an advance, but the report was doubted by the party from whom we learned it. Still it is the opinion that prices of machine tools have an upward tendency so far as they show any disposition to move at all.

The difficulty in carrying out new enterprises through the shortage of structural material is illustrated in the case of a company which has been incorporated to manufacture overhead cranes at Columbus, O. Work on this plant has been indefinitely retarded through inability to obtain the required material without waiting an inconscionable time or else paying an exorbitant price. One of the chief companies named ten months for delivery. Prices of structural steel for immediate delivery have been raised $3 to $5 a ton over rates recently in force. Billets are so scarce that steel mills are buying abroad.

Mr. Charles Churchill, of London, England, has arrived in the city and reports the business situation in machinery lines generally very good in Great Britain, at least so far as his experience goes. He says that although the South African War has interfered with machinery business in some lines, it has stimulated others and that in place of some of the trade he has lost owing to war operations they have been doing a considerable business with the Woolwich and other arsenals and also with private makers of war material. He thinks this war-stimulated business is about over now, however, and that upon the cessation of war business with private concerns will revive.

C. W. Burton, Griffiths & Co., London, have opened an auxiliary showroom with offices at 59 Finnieston street, Glasgow, for the purpose of extending their trade in that district. The heavy machine warehouse consists of a well-lighted shop 130 feet long by 30 feet wide by 50 feet high, with a 5-ton crane capable of running its entire length, while the light tool department consists of a warehouse facing Finnieston street, with show window. Both warehouses are fitted up with electric light, and are now well stocked with light and heavy tools.

The Niles-Bement-Pond Company has men at work installing the model toolroom which is to constitute a feature of its large showroom at 138 Liberty street, New York city.

The General Electric Company has purchased land in order to increase its works at Lynn, Mass., erecting a new three-story building 80x250 feet for the manufacture of instruments and meters, land for this structure having just been purchased. Other additions will also be made to the works there. It is said the company's Lynn force will be increased from 5,000 to 7,000 by the change, which seems a rather liberal estimate.

The Conradson Lathe Company, which some time ago decided upon Warren, Pa., as its location, has given the contract for its buildings to the Columbia Bridge Company, Pittsburgh. The machinery equipment will largely be furnished by the U. Baird Machinery Company and Brown & Zortman Machinery Company, Pittsburgh.

The Ball Engine Company, Erie, Pa., will erect a new engine-building plant from plans prepared by F. Felkel, of Pittsburgh. The machine shop is to be 136x200 feet, with a power building 60x80 feet. The works will be fully equipped with the latest type of tools.

The Pittsburgh Tool Steel Wire Company has been incorporated under Pennsylvania laws to manufacture high-grade drill rods and wire for use as material for needles, awls, taps, screw-drivers, nail sets, cork-screws, steel balls, roller bearings, etc. The company has an office at 317 House Building, Pittsburgh, and is erecting at Monaca, Pa., two buildings, 50x150 and 75x75 feet. Power will be supplied by a 100 horse-power Warren gas engine. Wm. Swindell & Bros. are furnishing the gas producers and annealing furnaces. It is expected that the plant will be in operation July 1. The president of the company is Werner Kaufman; vice-president and general manager, F. C. Eaton, who for the past eight years has been superintendent of the drill rod and wire department of the Crescent Steel Works, now a part of the Crucible Steel Company of America; secretary and treasurer, G. Stengel, Jr. Messrs. Kaufman & Stengel are steel merchants of Philadelphia.

The Francis Reed Company, manufacturer of upright drills, etc., Worcester, Mass., which has succeeded the George Burnham Company, announces in its new catalog that with the issue of same the company will occupy a new shop of its own. We note that a building permit has just been issued to the company for a machine shop 67x150 feet, which indicates that the company may already have felt the need of still larger facilities.

A 1,500 horse-power Nordberg engine, beside other other equipment, has been ordered for the Peninsula Electric Light & Power Company, Hancock, Mich.

The Chicago Pneumatic Tool Company has just received an order from one European concern for 150 pneumatic tools. The

company's foreign business has increased very rapidly during the past few months, and there is every indication that there will be a proportionate increase in the future.

It is now projected to establish a shipyard at Halifax, N. S., extensive enough for laying a keel 700 feet long. G. B. Hunter, of the Great shipbuilding firm, Swan & Hunter, is behind the project and H. Crowe is a promoter. The Nova Scotia Legislature has voted $100,000 for the enterprise, local aid has also been secured and it is being attempted to interest the Dominion Government. The boilers and engines would eventually be made by the establishment, though not at first.

CHICAGO MACHINERY MARKET.

Estimates of the current volume of business in machinists' supplies vary from that of a year ago to an increase of forty or fifty per cent. Last year's trade, it will be remembered, was phenomenal, surpassing all previous records. It was then regarded as a very formidable record with which to make future comparisons. Perhaps the gains this year create less surprise than did those of 1901, and the only explanation heard in reference to this increase in trade is general prosperity. And while some merchants and manufacturers are pointing to a forty or fifty per cent. gain there are others that are scarcely more than holding their own on the 1901 standard. For their failure to forge ahead again in business there is sometimes a ready reply. It is this: consumers are so delayed in procuring material, especially steel, that the shop activities are restricted. One manufacturer illustrates this condition by pointing to the fact that he is this year constructing a large shop out of brick and stone. He had expected to use steel, but when purchase of material was undertaken the depressing fact was elucidated that deliveries of shapes could not be promised within twelve months and were not even guaranteed then. Recourse to some other method of construction became necessary, for the erection of the building could not be deferred a year. But in machinists' tools and supplies the conditions of supply do not compare in severity with those of structural steel or of some of the cruder forms of metal material. There is slowness of deliveries quite commonly, but it is moderate in duration. A maker of taps, in reply to a large order for a special size from a Chicago buyer, said he was running twenty-three hours a day on regular sizes and under no circumstances would he turn to special work. Files are a little slow in getting forward and some other lines likewise.

Manufacturers who attended the Indianapolis convention last week comment favorably upon the appeal of Pre ident Search to maintain the export trade. The energetic efforts of New Orleans to secure the next convention are attributed to a desire of the live business men in that region to direct the attention of American manufacturers to the undeveloped resources of the lower Mississippi valley. Pittsburgh will probably have the convention in 1904.

The Machinists' Supply Company reports present business the best in their history. Samuel Harris & Co. say that in volume they have never had a demand to equal that of the present. The Norton Emery Wheel Company is running ahead of last year, April keeping about even with the large business of March. The Chicago Belting Company finds inquiries larger than ever before.

Quotations.

NEW YORK, Monday, April 21.

Pennsylvania Foundry Pig Iron, Jersey City delivery:

No. 1 X	$20 15 @$20 65
No. 2 X	19 65 @ 20 15
No. 2 plain	19 15 @ 19 65
Gray forge	18 65 @ 19 15

Alabama Pig, New York delivery:

No. 1 foundry, or soft	16 25 @ 19 25
No. 2 foundry, or soft	15 75 @ 18 75
No. 3 foundry	15 25 @ 18 25
Foundry forge, or No. 4	14 75 @ 17 25

The minimum quotations given above on Alabama irons are nominal. The actual price is somewhere near the maximum quotations.

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.93c. in carload lots. Smaller quantities from store, about 2.10c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.00 @ 2.10c.

Cold Rolled Steel Shafting—Base sizes—From store, 2¾c.

Copper—Lake ingot, 12 @ 12¼c.; electrolytic and casting, about 12c.

Pig Tin—In 5- and 10-ton lots, f. o. b., New York, 28¼c.

Pig Lead—4.10 @ 4.12½c. in 50-ton lots.

Spelter—4.35 @ 4.45c., New York delivery.

Antimony—Cookson's, 10 @ 10¼c., according to quantity upward from one cask; Hallett's and U. S., 8 @ 8⅜c.; various brands, 7¾ @ 8c.

Lard Oil—Prime City, 79 @ 82c., according to brand and quantity.

New Corporations.

Association of American Inventors & Manufacturers, Jamestown, N. Y. Capital, $25,000.

Loew Supply & Manufacturing Co., Cranford, N. J.; object, manufacturing tools, etc.; capital, $75,000. Incorporators: Stephen J. Cox, Herman Meyer and Stephen S. Newton.

Pollard-Alling Manufacturing Company, of Fishkill Landing, Dutchess County, N. Y., to manufacture folding and printing machines. Capital, $500,000.

Riley Engine Co., 123 Montgomery street, Paterson, N. J.; object, manufacturing motors, etc.; capital, $150,000. Incorporators: Wm. K. Riley, Henry B. King and Robt. H. Fordyce.

Robert Grant Co., 525 Main street, East Orange, N. J.; object, manufacturing distributing machines; capital, $500,000. Incorporators: C. V. Childs, James R. Mapletoft and H. N. Smith.

American Gas Engine Co.; object, making and selling gas, gasoline and petroleum engines; capital, $10,000. President, A. H. Mitchell; treasurer, C. W. Watson, both of Portland, Me.

N. E. Electric & Supply Corporation; object, making and dealing in electrical supplies; capital, $10,000. President, J. H. Collins, Lowell, Mass.; treasurer, Horace Mitchell, Kittery, Me.

American Solderless Can Co.; object, to manufacture cans and tin or other metals; capital, $5,000,000. Incorporators: Howard K. Wood, K. K. McLaren and F. A. Ashman, Jersey City, N. J.

Standard Specialty & Tube Co., 266 Main street, Paterson, N. J.; object, manufacturing collapsible tubes, etc.; capital, $30,000. Incorporators: David H. Kortendyke, J. B. Vreeland and R. E. Horton.

Manufacturers.

The Gloster (Miss.) Oil Company is building an oil mill.

Work has been begun on the factory of the Batavia (N. Y.) Clamp Company.

Stroud & Co., railroad supply contractors, will start a factory in Omaha, Neb.

Harrison Orwig is making arrangements to erect a boiler shop in West Niles, Ohio.

The Knoxville (Tenn.) Cotton Mills will enlarge their plant to accommodate looms.

The United Sash & Door Company, Wichita, Kan., will build an addition to its plant.

The Advance Veneer & Lumber Company, Indianapolis, Ind., is about to build a factory.

Work has begun on the foundation of the W. L. Velie Carriage Company's plant, Moline, Ill.

The Sharon Foundry Company, Sharon, Pa., will break ground for its plant at an early date.

Hugh Davy & Co., Mason City, Ia., have broken ground for a new sash and blind factory.

The W. W. Kimball Company, Chicago, Ill., pianos and organs, has bought land for an addition.

A portion of the plant of the Columbus (Ga.) Iron Works has been burned, but will be rebuilt.

The Minnesota Transfer Company, St. Paul, will purchase some new machinery for a repair shop.

The R. Herschel Manufacturing Company, mower knives, etc., Peoria, Ill., will build a new factory.

A new factory is about to be built for Yewdall & Jones, manufacturers of yarns, Philadelphia, Pa.

J. S. Springer, of Chicago, may organize a company to build a steel plant at Colorado Springs, Colo.

Work has begun on the foundation of a new crushing mill at Perry Bros.'s wharf, Rockland, Me.

The Sharon Brass Manufacturing Company, Sharon, Pa., has been organized with a capital stock of $30,000.

The Hard Manufacturing Company, manufacturer of wire mattresses, Buffalo, N. Y., is building a plant.

The Parish & Bingham Company, Cleveland, O., is about to build a plant for making lithographed tin cans.

The Globe Iron Foundry Company, Johns-

town, Pa., is to erect a new pattern shop, 20x 30 feet, one story.

Herman and C. Reiser, Lake Charles, La., are building a foundry in connection with their machine shop.

The William Tod Company, Youngstown, O., will build an addition to its plant to be used as an erecting shop.

Promoters are trying to raise $12,000 at Albion, N. Y., for the purpose of starting an emery wheel factory.

The Geo. W. Cope Pattern Works, manufacturers of stove patterns, Detroit, Mich., will build an addition.

The Consumers' Gas Company, Johnstown, Pa., is contemplating the installation of electric lighting machinery.

Additions are to be built to the plant of the Mayo Knitting Machine & Needle Company, Franklin Falls, N. H.

The Southern Cotton Oil Company, Montgomery, Ala., has bought land for cottonseed oil works at Pensacola, Fla.

An addition will be made to the foundry plant at the Chisholm & Moore Manufacturing Company works, Cleveland, O.

The Coventry Manufacturing Company, Providence, R. I., is to build an addition to its cotton mill at Anthony, R. I.

The Stromberg-Carlson Telephone Manufacturing Company, of Chicago, proposes to build a factory at Rochester, N. Y.

A new building will be erected by the Northwestern Foundry & Supply Company, Detroit, Mich., for use as a foundry room.

Rogers & Hemphill Machine Company, Alfred, N. Y., has been compelled to enlarge its sh p by building on another addition.

A permit has been issued for an addition to th factory of Belding, Paul & Co., manufacturers of silk ribbons, Montreal, P. Q.

The Chittenden Power Company, of Rutland, Vt., has increased its capital stock in order to enlarge and improve its plant.

The Pittsburgh Coal Company is now manufacturing cars at Coraopolis, Pa., and two coal flats have already been turned out.

The Alexander Smith & Sons' Carpet Company, Yonkers, N. Y., is about to erect another seven-story addition, 114x73 feet.

A site has been chosen and machinery contracts let for the plant near Alliance, O., of the Standard Bolt & Manufacturing Company.

A plant to manufacture chain will be established at Marysville, Pa., to be operated under the name of the Superior Chain Company.

Jay H. Newbury, manufacturer of pipe fittings, is preparing to erect a building for foundry purposes at his plant in Goshen, N. Y.

W. B. and J. Fleming, of Mannington, W. V., have purchased an acre of ground at Adamston, and will erect an oil tank factory upon it.

Harry G. Hart's iron foundry, Salem, N. J., is to be enlarged in the near future. J. W. Vanmeter has secured an interest in the company.

The Salem (Mass.) Electric Lighting Company has voted to increase its capital stock $100,000, to furnish money for increasing its plant.

The Lamb Knitting Machine Company, Chicopee Falls, Mass., proposes to build an addition, the plans for which have not matured.

Gruenhagen Brothers, St. Paul, Minn., expect to construct a new building for the manufacture of stoves and for storage purposes.

H. T. Bush and P. H. Pysher, of Noblesville, Ind., will build a plant at Detroit, Mich., which, it is understood, will be an enameling plant.

The Jackson Iron & Tin Plate Company, Clarksburg, W. Va., is to add several more mills to its plant, making it a ten-mill tin plant.

Julian Kennedy, Pittsburgh, Pa., has the contract to design two 400-ton-a-day blast furnaces for Rogers, Brown & Co., at Cleveland, O.

Plans have been filed in Philadelphia, Pa., for a five-story addition to the Pennsylvania Worsted Mills, at Fifty-fourth and Poplar streets.

Pass & Seymour, Inc., manufacturers of electrical supplies, Syracuse, N. Y., will, it is believed, soon increase the capacity of their factory.

It is reported that a shipbuilding plant is to be established at Port Burwell, Ont., by the Bertram Engine Works Company, Ltd., of Toronto.

A three-story structure, 141x188 feet, will be erected at Steger, Ill., for the Steger & Sons Piano Manufacturing Company, of Chicago, Ill.

It is stated from Niles, O., that extensive improvements are likely soon to be made at the Falcon plant of the American Steel Sheet Company.

The new plant of the West Jersey Tube Works, Bridgeton, N. J., will be started in the near future, as all the machinery is now on the ground.

Plans are being made for a three-story addition, 750x900 feet, costing $200,000, for the Globe-Wernicke Company, office fixtures, etc., Norwood, O.

George Becking, Chattanooga, Tenn., is building a factory which will be used for show cases and store fixtures or some related class of products.

An addition is to be built to the factory of the New Home Sewing Machine Company, at Orange, Mass. It will be used for the needle department.

The Canadian Minister of Militia says that the new Ross rifle factory to be erected shortly at Quebec will turn out from 15,000 to 20,000 rifles a year.

The plant of the Deposit Iron Company, Ltd., Deposit, N. Y., has been sold to Newark, N. Y., parties, who will enlarge it and employ 200 men.

Alterations and additions are being made on the plant of the J. H. Horne & Sons Company, Lawrence, Mass., manufacturer of paper mill machinery.

The Thatcher Manufacturing Company, Potsdam, N. Y., is thinking of constructing a paper mill and is obtaining information as to equipment, etc.

The China Manufacturing Company, cottons, Boston, Mass., has begun work on an addition to its mill at Suncook, N. H., for use as a weave shed.

Official announcement has been made that the National Steel Company will build another large blast furnace at New Castle, Pa., costing $700,000.

J. H. Peavey, of the Bangor (Me.) Edge Tool Company, has announced that its mill at Westfield, burned a few days ago, will probably be rebuilt.

Geo. C. Moore, North Chelmsford, Mass., wool scourer and manufacturer of worsted yarn, intends, it is understood, to build an addition to his mill.

The Gray-Blaisdell Company, Bradford, Pa., will add a foundry plant to its works. It will be the same size as the machine shop and will be thoroughly equipped.

Chief Birdsall of the Department of Water Supply of New York City recommends the erection of a new 100 horse-power boiler at Tottenville, Staten Island.

It is reported from Hainesport, N. J., that the Burlington County Traction Company has purchased the old foundry property and a power-house will be erected.

Plans have been filed for a two-story building, 36x85 feet, to be erected for the Keystone Telephone Company, at Preston and Filbert street, Philadelphia, Pa.

An addition will be built to the factory of the North Brothers Manufacturing Company, hardware specialties, Lehigh avenue and American streets, Philadelphia, Pa.

The Thew Automatic Shovel Company, Lorain, O., is to make further additions to its plant. The new addition will be of steel and brick and measure 100 feet in length.

The Barlow Manufacturing Company, Holyoke, Mass., manufacturer of brass and nickel-plated store and window fixtures, etc., and electroplater, is taking larger quarters.

The Rollins Engine Company, Nashua, N. H., will enlarge its plant and put in a traveling crane, etc., especially for the manufacture of the heavier class of engines.

A Pittsburgh building permit has been issued to the American Foundry & Construction Company for a two-story brick machine shop on Second avenue; estimated cost, $17,500.

The directors of the Monarch Cotton Mills, Union, S. C., have decided to increase the capacity of their plant. This will give space for 16,000 more spindles and 400 more looms.

The Elmira Rolling Mill Company has purchased a factory site at Elmira Heights, N. Y., where excavations have already been started and work is to be rushed on a modern steel bar mill.

The Keasbey & Mattison Company, Ambler, Pa., manufacturer of magnesia sectional covering, magnabestos and chemicals, will build an addition to its factory, 178x80 feet, five stories.

The officers of the Business Men's Association at Janesville, Wis., have signed a contract with a company which will build a plant there for the manufacture of cement fence posts.

Peter Reuter, president of the Bank of Kaukauna, Wis., and his son, A. L. Reuter, are the head of a sulphite manufacturing plant which they will soon build at Green Bay, to cost $100,000.

After three years' discussion the stove manufacturers of the United States are said to be perfecting a consolidation in which between forty and fifty of the largest plants will be united.

The new factory building which is about to be constructed by the Stanley Rule & Level Company, of New Britain, Conn., will be a five-story brick structure, 40x180 feet. It will cost about $40,000.

A two-story factory building will soon be erected in Des Moines, Ia., by St. John & Barquist. Machinery will be installed for the manufacture of cornices, steel ceilings and stamped metal work.

The site for shops of the new Knoxville, La Follette & Jellico Railroad, which will be built from Knoxville, Tenn., to Jellico to connect the Louisville & Nashville with the A., K. & N., has been selected.

A survey has been made by the Baltimore & Ohio at Fairmont, W. Va., for the purpose of erecting a roundhouse and shops. The plans are now in the hands of the Baltimore & Ohio officials at Baltimore, Md.

The plant of the Braddock Machine & Manufacturing Company at Braddock, Pa., recently purchased by the Carnegie Company, is to be enlarged. Changes in the machine shops and roll-making department will be made.

The Alliance Machine Company, Alliance,

O., has been organized by W. C. Whitehead, W. H. Purcel, W. S. Milbourn and others. New shops are about erected. All the machinery is to be electrically driven.

Edward D. Fitzpatrick is building a factory near Bristol, Conn., to which he will remove the machinery pertaining to the business of making clock dials, etc., formerly belonging to E. E. Newell, which he has purchased.

Mexican capitalists contemplate the erection of an iron works in Camden, N. J., to manufacture pig and billet from Mexican iron ore. The company will act under the name of the Mexican Iron Foundry of America.

The Marinette Iron Works Company, Marinette, Wis., will remove its plant to Warren, Pa., where a more suitable location has been secured. A foundry, 350 feet in length, and a machine shop, 400 feet, will be erected.

It is reported from Millbury, Mass., that the John Rhodes cotton mill has been purchased by the Holbrook Manufacturing Company, E. F. Rice, president. Most of the machinery will be replaced by new appliances.

A representative of the Wheeling & Lake Erie Railroad has purchased a farm of 200 acres at Navarre, the junction of the Cleveland, Toledo and Wheeling diivisions. It is thought to be preliminary to the erection of shops.

A new oil mill will be built at Grenada, Miss. The stockholders have elected Geo. W. Armstrong, of Coffeeville, president; J. S. Perry, of Grenada, secretary, and B. C. Duncan, treasurer. The capital stock is $50,000, all paid in.

It is reported that a Syracuse, N. Y., company has been organized for the manufacture of paper and that Architects Taber & Draper have been commissioned to prepare plans and specifications for a factory building, about 100x350 feet.

J. B. Richards, treasurer of the Davis mill, Fall River, Mass., is figuring with mill machinery manufacturers of this country and with representatives of the English manufacturers relative to the contracts for machinery for the new mill.

The National Lumber Company, of which J. V. Goode is president and whose main office is located in Fort Worth, Tex., is said to have decided to erect a plant at some point in the State for the chemical treatment of railroad ties and timber.

The Leader Manufacturing Company, of Hartford, Conn., has been organized by Glastonbury and Hartford capitalists. The capital stock is $25,000, and the company will manufacture machinery, tools, hardware and household furnishings.

Plans and specifications are being prepared for a manufacturing plant to be erected at Harrison, N. J., for the American Radiator Company, of Chicago and Detroit. The main building will be 145x110 feet, equipped with traveling cranes.

The stockholders of the Commercial Envelope Company, Ltd., Binghamton, N. Y., have voted to increase the capital stock from $60,000 to $125,000. The company proposes to erect a new building and make an addition to its mechanical plant.

The Lewis Foundry & Machine Company, of Pittsburgh, Pa., has greatly increased its force of employees at its plant at Coraopolis. The plant manufactures chilled steel rolls, and recently added a night force. Two hundred and fifty men are now employed.

The contract to furnish the mills for the new plant of Follansbee Bros. Company, Pittsburgh, Pa., has been awarded to the Wheeling Mold & Foundry Company, Wheeling, W. Va. There will be four hot and one cold sheet mill, one roughing mill, four hot and five cold tin mills.

H. J. Breeze, an inventor from Port Huron, Mich., has been in Milwaukee, Wis., to arrange for starting a factory for the manufacture of a pneumatic horse collar of which he is the inventor. He expects soon to incorporate a company with a capital stock of $100,000.

The Hennecke-Walker Manufacturing Company has been formed in Milwaukee, Wis., and has secured factory quarters on Lake street, where it will open for business about May 1. The capital stock is $10,000. The company will manufacture machinists' tools and machinery of various kinds.

Chas. A. Dawson & Son, of the Dawson Manufacturing Company, Holden, Mass., have bought old mills at East Holliston, Mass., which they will enlarge and use for the manufacture of thibet cloth. Some of the present machinery is to be sold and some kept and adapted to the style of goods manufactured.

Contracts have been awarded for erecting a two-story manufacturing building for the Clayton & Lambert Manufacturing Company, Detroit, Mich., manufacturer of plumbers' and tinners' tools, etc. The building will be in the form of a "T," with a frontage of 120 feet, the depth at the center being also 120 feet.

The Wausau (Wis.) Sandpaper Company has been incorporated. The incorporators and stockholders are W. W. Albers, E. C. Kretlow, T. M. Smith, John Johnson, C. S. Curtis, Joseph Pope, W. Kuckuk, C. S. Gilbert and Barney Baumann. The capital stock is $100,000 and the company intends building a plant at once.

It is stated in Philadelphia, Pa., that plans for new buildings for the Duryea Knitting Mills Company, to be erected in Duryea, near Scranton, Pa., have been finished by Amos W. Barnes, architect and engineer, and forwarded to the owner, who will take bids. A two-story mill, 150x40 feet; a dye-house, boiler-house, engine-house and office are included.

M. A. Hanna & Co., of Cleveland, Ohio, and others have decided to build a blast furnace in Detroit, Mich., with a capacity of 250 to 300 tons of foundry iron per day. The company is being incorporated under the laws of Michigan, with $1,500,000 capital stock, and will be known as the Detroit Iron & Steel Company.

The Sprague Electric Company has moved its Boston office into new and larger quarters situated in the Weld Building, 176 Federal street. H. C. Farnsworth continues as manager of the Boston office. He has recently added to his staff George D. Simmons, who was formerly superintendent of the Hawks Electric Company.

Additions are to be built to the Waukesha (Wis.) Malleable Iron Works. It has been decided to enlarge the foundry building by an extension 300 feet long with two 50-foot ells. The main extension will be 70 feet wide. New machinery will be installed with other equipment. A 60-foot addition will be built to the machine department.

The Lumiere North American Company is about to build a plant at Howard Park, at or near Burlington, Vt., for the manufacture of photographic plates, etc. The plans were drawn by Architect Fred S. Hinds, of Boston, and the constructing engineer and technical manager is C. Pouloillon, of Paris. The general manager is F. G. White.

It has been decided in York Haven, Pa., to organize the Susquehanna Roofing Manufacturing Company, Limited, for manufacturing tar roofing paper at Cly, near there. The following officers have been elected: President and general manager, C. C. Eastlack; vice-president, E. R. Owen; secretary and treasurer, A. G. McLauchlin.

The Tway Steel Forge & Machine Compnay (capital, $100,000) has just been incorporated in Camden, N. J., by Arthur Bruce, Jerome J. Wood and Edward L. Dodin. The company has purchased two acres of land at Bulson street and Mount Ephraim avenue, on which it will erect a shop, 70x200 feet. It will employ about 100 hands.

It is reported that the Standard Screw Company, of Worcester, Mass., which owns the Detroit (Mich.) Screw Works, has decided to consolidated its Western plants in Detroit, and will erect a big factory. The Chicago plant of the company will be moved there. The present plant at Detroit may be provisionally enlarged by erecting another story.

The American Bridge Company has secured a contract from the Pennsylvania Engineering Works, of New Castle, calling for the construction of a boiler-making shop which will be over 300 feet long and which will be equipped with some of the most modern machinery. The Pennsylvania Engineering Company recently increased its capital stock from $500,000 to $1,000,000.

The Atlantic Pulp & Paper Company, Limited, recently incorporated under the laws of Canada, with a captial of $3,000,000, will build mills on the Little Cascapedia river, at New Richmond, on the Baie des Chaleurs. The officers include W. C. Edwards, of W. C. Edwards & Co., Limited, lumbermen, Ottawa, president, and R. Y. Ellis, vice-president. Among the directors is Chas. H. Waterous, president of the Waterous Engine Works Company, Limited, of Brantford.

According to news from Boston Mass., the White Mountain Paper Company is preparing to build its large pulp and paper manufacturing plant at Portsmouth, N. H. The company proposes to erect a plant capable of producing 200 tons of news print and 300 tons of book paper per week. It has acquired water power of 30,000 horse-power on the Saco and Salmon Falls rivers. The contracts for a large quantity of paper machinery were to be let a few days ago.

Articles of incorporation have been filed under the laws of New Jersey for the Steel Reutilization Company, with a capital of $1,000,000. The incorporators are Abel E. Blackmar, Lucius E. Judson and K. K. McLaren. The company has acquired the rights in the United States patents of James E. York for rerolling worn rails and for the manufacture of steel ties from old rails. The "principal office" is at Corporation Trust Company, 15 Exchange place, Jersey City, N. J.

The Cleveland Litholite Company has been incorporated to build a foundry for casting ornamental stone at Cleveland, O. The officers are Frank C. Osborn, of the Osborn Engineering Company, president; C. F. Lake, Jr., vice-president; B. L. Green, secretary; L. C. Middough, treasurer. The process is to break the stone from the quarries into particles, mix it with Portland cement and place it in molds. The product is claimed to be stronger than original stone, to absorb less water, and resist the action of fire. By crushing granite and coloring it with iron, a brown stone has been produced, which is said to resemble the real closely.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 18.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Stamping dies. Emmons Collins, Chicago.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Patterns and models. 18 Thames st., N. Y.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Fine machine and experimental work. The Des Jardins Type Justifier Co., Hartford, Ct.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Light machine & experimental work; models made. S. Messerer, 15 Springf. av., Newark, N.J.

Draw bench wanted, 20 feet long and powerful. Send particulars and price to J. G. Wilson, 3 W. 29th st., N. Y. City.

Purchaser for complete sets of universal radial and plain upright drill patterns with drawings; for sale cheap. Address "Patterns," care AMERICAN MACHINIST.

Special tools, models, fine light machinery, experimental and electrical work wanted, also specialties to manufacture. The General Mfg. Co., 40 West 13th st., New York City.

Machinery designed, mechanical drawings, blueprints, plans for power-houses, power transmission; 20 years' experience. "Engineer and Draftsman," Box 344, AM. MACH.

Purchaser for small manufacturing plant in Madison, Wis.; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Charles City, Iowa.

Wanted—Partner with capital; gentleman with business ability, enterprise and capital can learn of opportunity for permanent, lucrative manufacturing business; machine shop and foundry. Address "Experienced Mechanic," Box 390, AMERICAN MACHINIST.

For Sale, Cheap—Two colored tool tempering charts, explaining all tempering to a standard, in oil, water or tallow, making all tools with hard, tough edge, and 40 new steel-working receipts; all for $1. W. M. Toy, Sidney, O. (40 years a factory steel worker).

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents.

Situations Wanted.

Wanted—Position as assistant draftsman; reference given. Box 399, AMER. MACH.

Draftsman, mechanical, 12 years' experience, desires position. Box 406, AM. MACH.

20 years designing, machinery, inventions; work home; situation. 433 Dekalb av., B'klyn.

Draftsman, electrical engineer, expert on wiring, wants position. Box 410, AM. MACH.

Position of responsibility by an up-to-date machine shop or toolroom foreman. Box 397, AMERICAN MACHINIST.

Cost accountant, experienced, thoroughly competent, latest system, wishes change. Box 376, AMERICAN MACHINIST.

Draftsman (foreign) desires position; 2 years shop, 4 years drafting (pump and general machinery). Box 404, AMER. MACHINIST.

Mechanical engineer; 25 years' experience, marine and Corliss engine work; estimater, designer and shop superintendent. Box 409, AMERICAN MACHINIST.

Mechanical engineer, graduate, extensive experience in gasoline engines and automobile, seeks responsible position. Address "Auto," care AMERICAN MACHINIST.

Wanted—By practical young machinist, position as instructor in shop practice; one year's experience as teacher; best instructional methods. Box 391, AMERICAN MACHINIST.

I wish to identify myself with a manufacturing concern as engineer or chief draftsman; I have a few thousand dollars to invest if favorable opportunity offers. Box 380, AMERICAN MACHINIST.

As superintendent and mechanical engineer; now holding like position, building high-speed automatic and Corliss engines; up-to-date designer; good executive ability. "Output," care AMERICAN MACHINIST.

Wanted—Position as pusher or assistant superintendent; I can get your work from the foundry to cars on time; 8 years' experience in large, up-to-date machine shop. Address "Pusher," care AMERICAN MACHINIST.

Open for engagement, designer of presses, eyelet, rivet, thread-rolling, pin-pointing, hook and eye, wire-forming, screw-slotting and special automatic machinery; 15 years' experience. Box 393, AMERICAN MACHINIST.

Position as superintendent or foreman, by practical mechanic, up to date in modern methods, organizing and the handling of men to obtain best results; interchangeable machinery and specialties. Box 348, AM. M.

Mechanical engineer and draftsman wishes to make change; 18 years' experience as foreman, master mechanic and superintendent, manufacturing small interchangeable machinery and sheet-metal goods. Address Box 392, AMERICAN MACHINIST.

By experienced superintendent of machine shop and foundry; modern, aggressive, good executive; technical graduate; wide general experience; now with concern manufacturing pumping machinery; soon open to engagement. Box 402, AMERICAN MACHINIST.

First-class foreman machinist, 22 years' experience, 6 years as foreman and general foreman, on high-grade machine tools, good organizer and handler of men, with first-class recommendations, desires a change the first of May, where energy and ability are wanted. Box 400, AMERICAN MACHINIST.

Machine shop foreman will be open for a position in a short time; can handle men to advantage and understands modern system of getting out work; a practical man and a hustler; gas engine or automobile work preferred; references as to character and ability. Address A. G., care AMERICAN MACHINIST.

Position as foreman of tool, model or similar department, by first-class toolmaker, experienced on jigs, fixtures, gages, etc., watch tools and experimental work; fair technical education and thorough knowledge of modern shop methods; age 28; now in Massachusetts. Box 405, AMERICAN MACHINIST.

Machinery salesman, well educated, practical mechanic, with years of commercial experience, who has spent the last few years in Europe selling American machinery, with good results, having excellent connections abroad, has just returned and is open for engagement; excellent references. Box 407, AMER. MACH.

Wanted—Position as general foreman or superintendent; young, energetic, successful, in design of tools, up-to-date methods and general superintendence; a practical man, who knows how to mind his business and get the work out; special machinery, tools, specialties; A1 references. Box 403, AMER. MACH.

Mr. Manager: I have been 16 years in the mechanical business; served an apprenticeship where they built good work; knocked around some; had experience on special machinery, interchangeable work tools, models, gages and light manufacturing; held positions of responsibility; have one at present and want a better one in the East. Do you want a steady, industrious man for superintendent, master mechanic or general foreman who doesn't claim to know everything, but something, and can refer to people who have made money in the business that consider he is better than the average? Box 401, AMER. MACHINIST.

Help Wanted.

Machinists to sell my calipers, etc.; big inducements. E. G. Smith, Columbia, Pa.

Wanted—25 good machinists and toolmakers. Apply Box 365, AM. MACHINIST.

Wanted—A number of good patternmakers. Call or address De Laval Steam Turbine Co., Trenton, N. J.

Wanted—A first-class machinery salesman for New York and vicinity. The Fairbanks Co., Broome and Elm sts.

We are enlarging our plant and would like applications from first-class machinists. Box 340, AMERICAN MACHINIST.

Wanted—Several good patternmakers, by a machine tool manufacturing works in Jersey. Box 179, AMERICAN MACHINIST.

Wanted—First-class toolmakers and machinists, also patternmaker, in the Middle West. Box 411, AMERICAN MACHINIST.

Six first-class molders for Corliss engines and other heavy machine castings. Address "Manufacturer," care AMER. MACHINIST.

Wanted—By R. Hoe & Co., an expert man on punching and shearing machines. Apply at works, Grand and Sheriff sts., New York City.

Machinists wanted to act as shop agents and sell small tools where they work. Address E. H. Randall, 235 Woodland ave., Springfield, Ohio.

Wanted—Men, 25 to 35, handy on small tools and clock work. Apply, with references, at Gilbert Clock Co., office, 37-39 Maiden Lane, at 10 A. M., April 28.

Wanted—A few first-class detail or leading draftsmen on locomotive work; give age, experience, education and salary expected. Box 388, AMERICAN MACHINIST.

Experienced draftsmen; must be first-class, especially in brake and truck work; give age and reference. Address Westinghouse Air-Brake Company, Wilmerding, Pa.

Foreman diemaker, thorough experience on combination dies for cans and tinware, required; state experience and age. Address Box 394, AMERICAN MACHINIST.

Wanted—A few mechanical draftsmen for tool and fixture work; state age, experience and salary; permanent position to good men. Address Box 355, AMERICAN MACHINIST.

Wanted—First-class machinists, for steady employment in Greater New York; married men preferred; in application give experience, references, age and wages expected. Box 396, AMERICAN MACHINIST.

Wanted—Superintendent or foreman, by parties contemplating the manufacture of typewriters; prefer party with experience in that line or similar line. Address J. F. Lawrence, 985 North Clark st., Chicago.

Wanted—Good machinist, to erect small vertical steam engines; one who thoroughly understands engine work; when writing, give age, experience and wages desired. Address Wm. E. Hill & Co., Kalamazoo, Mich.

Wanted—In the West, first-class machinist; one who is aspiring for promotion; state fully experience, together with wages to commence with; none but a thorough up-to-date man need apply. Box 408, AMER. MACHINIST.

Wanted—Superintendent for manufacturing plant; must be accustomed to shop management; man with experience in building large valves preferred. State experience and wages desired. Box 366, AMERICAN MACHINIST.

Wanted—In New York, Pittsburgh and Boston, three salesmen to sell water tube steam boilers of a well-known make on commission; first-class reference required as to character and ability. Address Box 395, AMER. MACH.

Machinists Wanted.—We need 30 lathe hands and 20 planer hands for night gang on heavy machine tool work; to work 12 hours per night, five nights per week; good pay to good men. Apply to The Pond Machine Tool Co., Plainfield, N. J.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

As they are about to enlarge their plant, R. Hoe & Co. are in need of good vise hands, good machine hands for turret lathes, milling machines, vertical boring machines, also expert drill press hands. Apply at works, Grand and Sheriff sts., New York City.

Wanted—Foreman for machine shop and one for foundry, in growing engine works in Pennsylvania city of 40,000; employ 10 to 25 men in each department; permanent positions and good pay to right parties. M. L. Co., care AMERICAN MACHINIST.

Wanted—First-class designer and draftsman on labor-saving tools; character of machinery and tool to be brought out are for brass and iron valves and iron pipe fittings. State age, experience and salary expected. Box 364, AMERICAN MACHINIST.

Wanted—Manager for machine tool works, competent to assume full management, fully conversant with up-to-date wants and methods; deceased party's stock; whole or part could be secured; give full particulars. Address Box 389, AMERICAN MACHINIST.

Competent office man with sufficient mechanical knowledge to properly manage old-established gas engine works; state salary expected, experience, age, etc.; a working interest also at present and stock later if agreeable. Address "Chance," care AMER. MACH.

Wanted—Thoroughly competent foreman on machine tool building, experienced in building pipe threading machinery, familiar with methods of producing duplicate parts on turret lathes; give age, experience, salary expected and references. Box 237, AMER. MACH.

Wanted—Thoroughly competent foreman for automatic and hand screw machine department; must be familiar with Cleveland and Hartford style of automatic screw machines and capable of turning out accurate work; give age, experience, salary expected and references. Box 381, AMER. MACHINIST.

Wanted—A thoroughly competent foreman for a machine shop of some pretensions; a technical graduate with up-to-date ideas of the most approved machine shop practice preferred; an excellent opportunity near New

York for the right man. Address Box 397, AMERICAN MACHINIST.

Wanted.—Men with brains wanted, who can make drawings requiring technical training and practical engineering experience; no draftsmen need apply; commensurate salary for proved ability; in replying give age, references, experience and salary. Address Box 412, AMERICAN MACHINIST.

Wanted—General foreman or superintendent for large machine shop in Ohio doing general machine work and building gas engines; must be a thorough mechanic and familiar and experienced in gas engine work and handling men under piece or premium systems; must also be familiar with foundry practice and pattern work; state age, experience, married or single, salary, etc. Address H. D. C., care AMERICAN MACHINIST.

Wanted.—Machinists, toolmakers, draftsmen, do you want to increase your salary? They all say that Saunders' enlarged edition "Hand Book Practical Mechanics" exactly fills the bill for valuable shop kinks, rules, etc., figured out by simple arithmetic and drawings; also most complete reference tables in existence, many taken from note books of best mechanics in the country. Pocket size. Price, post paid, only $1, cloth; $1.25 leather. Agents wanted. Book sells itself. Big money. C. H. Saunders, 216 Purchase st., Boston, Mass.

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Western Electric Co	70
West Haven Mfg. Co	4th Cover
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Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.

Arbor Press

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.

Balls, Steel

Automobile & Cycle Parts Co., Cleveland, O.
Grant Tool Works, Franklin, Pa.

Bars, Boring

Cleveland Twist Drill Co., Cleveland, O.
Underwood & Co., H. B., Philadelphia, Pa.

Belting, Leather

Shultz Belting Co., St. Louis, Mo.

Bearing Metal

Phosphor Bronze Smelting Co., Philadelphia, Pa.
Shonberg, I., New York.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.

Belt Lacing Machines
Diamond Drill & Mach. Co., Birdsboro, Pa.

Bending Machines, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Reade Mchry Co., Cleveland, O.

Blocks and Tackles
See Hoists, Hand.

Blowers
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

Blue Printing Machines
Pittsburgh Blue Print Co., Pittsburgh, Pa.

Blue Print Wringers
Pittsburgh Blue Print Co., Pittsburgh, Pa.

Boilers
Struthers, Wells & Co., Warren, Pa.

Bolt and Nut Machinery
Acme Mchry Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.

Books, Mechanical
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Henley & Co., N. W., New York.

Boring and Turning Mills
Am. Tool Wks. Co., Cincinnati, O.
Baush Mach. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., N. Y. City.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Dallett & Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Franklin Mach. Wks., Phila., Pa.
Jones Fdry & Mch. Co., W. A., Chicago, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.

Carborundum
See Grinding.

Castings, Brass and Bronze
Christensen Engineering Co., Milwaukee, Wis.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Motor
Ferodowili & Co., J. H., St. Paul, Minn.

Castings, Steel
Acme Steel & Mall. Iron Works, Buffalo, N. Y.
Christensen Engineering Co., Milwaukee, Wis.
Uniform Steel Co., Newark, N. J.
U. S. Steel Co., Everett, Mass.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Centering Machines
Bement, Miles & Co., New York.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Chains, Crane
Columbus Chain Co., Columbus, O.

Chains, Driving
Automobile & Cycle Parts Co. Cleveland, O.
Boston Gear Works, Boston, Mass.
Columbus Chain Co., Columbus, O.
Jeffrey Mfg. Co., The, Columbus Ohio.
Link Belt Engr. Co., Phila., Pa.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Cleveland Mach. Screw Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K. Cincinnati, O.
Potter & Johnston Mach. Co. Pawtucket, R. I.
Pratt & Whitney Co., Hartford Conn.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven Conn.
Cleveland Twist Drill Co., Cleveland, O.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Sons Co., Windsor Locks, Conn.
Pratt & Whitney Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Faneuil Watch Tool Co., Boston, Mass.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Oesterlein Mach. Co., Cincin., O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.

Codes
Lieber Code Co., New York.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen Engineering Co., Milwaukee, Wis.
Clayton Air Comp. Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
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Countershafts
Builders' Iron Fdry., Provi., R. I.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Couplings, Shaft
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Jones Fdry & Mch. Co., W. A., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Counting and Printing Wheels
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machines
Underwood & Co., H. B., Philadelphia, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey, City, N. J.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Cutting off Machines
Bement, Miles & Co., New York.
Davis Mach. Co., W. P., Rochester, N. Y.
Franklin Mach. Wks., Phila., Pa.
Huribut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.

Drawing Boards and Tables
Rich, J. & G., Philadelphia, Pa.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Wks., Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Dallett & Co., Thos. H., Phila., Pa.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.

Drilling Machines, Radial
Amer. Tool Wks. Co., Cincin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Fosdick & Holloway M. T. Co., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
Am. Tool Wks. Co., Cincinnati, O.
Aurora Tool Wks., Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb & Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Elec. Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
General Elec. Co., New York.
General Incan. Arc Light Co., New York.
Triumph Electric Co., Cincin., O.
Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Whiting Fdry. Equipment Co., Harvey, Ill.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Charter Gas Engine Co., Sterling, Ill.
Columbus Mach. Co., Columbus, O.
Foos Gas Eng. Co., Springfield, O.
Maywood Foundry & Mach. Co., Chicago, Ill.
Mietz, August, New York.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Patterson, Gottfried & Hunter, Ltd., New York.
Regal Gas Engine Co., Coldwater, Mich.
Springfield Gas Eng. Co., Springfield, O.
Struthers, Wells & Co., Warren, Pa.
Weber Gas & Gasoline Eng. Co., Kansas City, Mo.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.

Engine Stop
Consolidated Engine Stop Co., New York.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Elec. Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Troy File Works, Troy, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Forges
Buffalo Forge Co., Buffalo, N. Y.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal, Gas and Oil
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gas Producers
Am. Gas Furnace Co., N. Y. City.

Gear Calculator
Wallace, D., Brooklyn, N. Y.

Gear Cutting Machinery
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Cleveland Gear Wks., Cleveland, O.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Son, Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
N. Y. Gear Works, Brooklyn, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Molded
Greenwald Co., I. & E., Cincin., O.
Poole & Son Co., Robt., Baltimore, Md.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Modern Tool Co., Erie, Pa.
Norton Emery Wheel Co., Worcester, Mass.
Oesterlein Mach. Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., Provi., R. I.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Northampton Emery Wheel Co., Leeds, Mass.
Oesterlein Mach. Co., Cincin., O.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., Provi., R. I.
Landis Tool Co., Waynesboro, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Phila., Pa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Millers Falls Co., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Eng. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Handles, Machine Tool
Schacht Mfg. Co., Cincinnati, O.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.
Whiting Fdry. Equipment Co., Harvey, Ill.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Instruction Schools
See Schools, Correspondence.

Instruments, Drawing
Alteneder & Son, Phila., Pa.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Keys, Machine
Whitney Mfg. Co., Hartford, Ct.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchy. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.

Lamps, Arc
General Electric Co., N. Y. City.
Gen. Incan. Arc Light Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes
American Tool Wks. Co., Cin., O.
Auto. Mach. Co., Bridgeport, Ct.
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard Mach. T. Co., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.

Lathes—*Continued*
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Provi., R. I.
Fairbanks Mch. Tool Co., Springfield, O.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Grant Tool Co., Franklin, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Striet Mach. Co., A., Cincinnati, O.

Letters, Pattern
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Columbia Factory, Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Stowell, J. A., Leominster, Mass.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb & Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Oesterlein Mach. Co., Cincin., O.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Provi., R. I.
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Grant Tool Wks., Franklin, Pa.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Oesterlein Mach. Co., Cincin., O.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Niles Tool Works Co., New York.
Oesterlein Mach. Co., Cincin., O.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., Westville, Ct.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines
The Adams Co., Dubuque, Iowa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Mortising Machines, Chain
New Britain Mch. Co., New Britain, Conn.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Electric Co., New York.
General Incan. Arc Light Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Murdock Parlor Grate Co., Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Co., Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Houghton & Co., E. F., Philadelphia, Pa.

Packing, Steam Joint
Jenkins Bros., New York.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Bevans, James W., Washington, D. C.
Cromwell, W. H., Washington, D. C.
Cullen, Orlan Clyde, Washington, D. C.
Patent Title & Guarantee Co., New York.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fay & Scott, Dexter, Me.

Patterns, Wood
Balkwill Pattern Works, Cleveland, Ohio.
Gobeille Pattern Co., Cleveland, O.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer, Jack
Armstrong Bros. Tool Co., Chicago, Ill.

Planers
Amer. Tool Wks. Co., Cincin., O.
Bartlett, E. E., Boston, Mass.
Belmer-Eames Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.

Planers—*Continued*
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Franklin Mach. Wks., Phila., Pa.
Newton Mch. Tool Works, Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Phila., Pa.

Presses, Hand
Elmes Eng. Co., Chas. F., Chicago, Ill.

Presses, Hydraulic
Bement, Miles & Co., New York.
Elmes Eng. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.

Profilers
Garvin Mach. Co., New York.

Pulleys
American Pulley Co., Phila., Pa.
Cresson Co., Geo. V., Philadel., Pa.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Poole & Son Co., Robt., Baltimore, Md.
Reeves Pulley Co., Columbus, Ind.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Striet Mch. Co., A., Cincinnati, O.

Pumps, Hydraulic
Elmes Eng. Co., Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Wks., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Van Dorn & Dutton Co., Cleve., O.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Cleveland Twist Drill Co., Cleveland, O.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Rheostats
General Incan. Arc Light Co., New York.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Eng. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.

Roller and Ball Bearings
Ball Bearing Co., Philadel., Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Roller Bearing & Equipment Co., Keene, N. H.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.

Schools, Correspondence
Amer. School of Correspondence, Boston, Mass.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
Ohio State University, Columbus, Ohio.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Machine Screw Co., Cleveland, Ohio.
Dreses, Mueller & Co., Cincin., O.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mch. Screw Co., Cleveland, O.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Shafts, Flexible
Chicago Flexible Shaft Co., Chicago, Ill.

Second Hand Machinery
Baird Machy. Co., U., Pittsburgh, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegeny, Pa.
Dawson, John H., Chicago, Ill.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hall's Sons, Sam'l, New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wormer Machy. Co., C. C., Detroit, Mich.

Shapers
Amer. Tool Wks. Co., Cincin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Smith & Mills, Cincinnati, O.
Steptoe & Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett Co., E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Franklin Mach. Wks., Phila., Pa.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Speed Limit System
Consolidated Engine Stop Co., New York.

Springs
Cleveland Wire Spring Co., Cleveland, O.

Sprocket Chains
See Driving Chains.

Stamps, Letters and Figures
Schwerdtle Stamp Co., Bridgeport, Conn.

Stampings, Sheet Steel
Automobile & Cycle Parts Co., Cleveland, O.

Steel, Machinery
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Automobile & Cycle Parts Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Patriarche & Bell, New York.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.

Taps, Collapsing
Geometric Drill Co., Westville, Ct.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick & Holloway Mach. Tool Co., Cincinnati, O.
Garvin Mach. Co., New York.
Geometric Drill Co., Westville, Ct.
Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Webster & Perks Tool Co., Springfield, O.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clarke Auto. Telephone Switch Board Co., Providence, R. I.

Threading Dies, Opening
Errington, F. A., New York.
Geometric Drill Co., Westville, Ct.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., The, Cleveland, O.
Pratt & Whitney Co., Hartford, Ct.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
McCrosky & Huber, Cincinnati, O.

Tools
See Machinists' Small Tools.

Transmission Machinery
Allston Foundry Co., Boston, Mass.
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson & Co., Geo. V., Phila., Pa.
Jones Fdry. & Mch. Co., W. A., Chicago, Ill.
Link-Belt Engineering Co., Philadelphia, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Traps, Steam
Houghton & Co., E. F., Philadelphia, Pa.

Trolleys and Tramways
Brown Hoisting Machy. Co., N. Y. City.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Whiting Fdry. Equip. Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Trimmers, Wood
Amer. Mchry. Co., Grand Rapids, Mich.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Washburn Shops, Worcester, Mass.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Barker & Chard M. T. Co., Cin., O.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Cleveland Mach. Screw Co., Cleveland, O.
Dreses, Mueller & Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
Standard Tool Co., Cleveland O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.

Valves
See Steam Fittings.

Vises, Drill
Hollands Mfg. Co., Erie, Pa.

Vises, Metal Workers'
Hammacher Schlemmer & Co., New York.
Hollands Mfg. Co., Erie, Pa.
Parker Co., Chas., Meriden, Conn.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Worm Hobbing Machines
Grant Tool Wks., Franklin, Pa.
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Mach. Screw Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.